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CHECO

SOUTHEAST ASIA

REPORT

USAF TACTICAL RECONNAISSANCE IN SOUTHEAST ASIA

PART 3

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14. ABSTRACT

Project CHECO was established in 1962 to document and analyze air operations in Southeast Asia. Over the years the meaning of the acronym changed several times to reflect the escalation of operations: Current Historical Evaluation of Counterinsurgency Operations, Contemporary Historical Evaluation of Combat Operations and Contemporary Historical Examination of Current Operations. Project CHECO and other U. S. Air Force Historical study programs provided the Air Force with timely and lasting corporate insights into operational, conceptual and doctrinal lessons from the war in SEA.

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PROJECT CHECO
Contemporary Historical Examination of Current Operations REPORT

"USAF TACTICAL RECONNAISSANCE IN SOUTHEAST ASIA" JULY 69 - JUNE 71

23 NOVEMBER 1971

HQ PACAF

Directorate of Operations Analysis
CHECO/CORONA HARVEST DIVISION

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DEPARTMENT OF THE AIR FORCE
HEADQUARTERS PACIFIC AIR FORCES
APO SAN FRANCISCO 96553

PROJECT CHECO REPORTS

The counterinsurgency and unconventional warfare environment of Southeast Asia has resulted in the employment of USAF airpower to meet a multitude of requirements. The varied applications of airpower have involved the full spectrum of USAF aerospace vehicles, support equipment, and manpower. As a result, there has been an accumulation of operational data and experiences that, as a priority, must be collected, documented, and analyzed as to current and future impact upon USAF policies, concepts, and doctrine.

Fortunately, the value of collecting and documenting our SEA experiences was recognized at an early date. In 1962, Hq USAF directed CINCPACAF to establish an activity that would be primarily responsive to Air Staff requirements and direction, and would provide timely and analytical studies of USAF combat operations in SEA.

Project CHECO, an acronym for Contemporary Historical Examination of Current Operations, was established to meet this Air Staff requirement. Managed by Hq PACAF, with elements at Hq 7AF and 7AF/13AF, Project CHECO provides a scholarly, "on-going" historical examination, documentation, and reporting on USAF policies, concepts, and doctrine in PACOM. This CHECO report is part of the overall documentation and examination which is being accomplished. It is an authentic source for an assessment of the effectiveness of USAF airpower in PACOM when used in proper context. The reader must view the study in relation to the events and circumstances at the time of its preparation--recognizing that it was prepared on a contemporary basis which restricted perspective and that the author's research was limited to records available within his local headquarters area.

ERNEST C. HARDIN, JR., Major General, USAF
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     - (2) AF/SAMI 1
   - d. AF/SAJ. 1
   - e. AFIGO
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     - (2) IGS 1
   - f. AFSG. 1
   - g. AFINATC 5
   - h. AFACMI. 1
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     - (4) AFRDR. 1
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     - (4) AFSSS. 1
     - (5) AFSTP. 1
   - m. AFTAC. 1
   - n. AFXO 1
     - (1) AFXOB. 1
     - (2) AFXOD. 1
     - (3) AFXODC 1
     - (4) AFXODD 1
     - (5) AFXODL 1
     - (6) AFXOOG 1
     - (7) AFXOSL 1
     - (8) AFXOOSN. 1
     - (9) AFXOOSO. 1
     - (10) AFXOOSS. 1
     - (11) AFXOOSV. 1
     - (12) AFXOOTR. 1
     - (13) AFXOOTW. 1
     - (14) AFXOOTZ. 1
     - (15) AF/XOX 6
     - (16) AFXOXXG. 1

3. MAJOR COMMAND

a. TAC

(1) HEADQUARTERS
- (a) DO. 1
- (b) XP. 1
- (c) DOCC. 1
- (d) DREA. 1
- (e) IN. 1

(2) AIR FORCES
- (a) 12AF
  - 1. DOO. 1
  - 2. IN 1
- (b) 19AF(IN). 1
- (c) USAFSOF(DO) 1

(3) WINGS
- (a) 1SOW(DOI) 1
- (b) 23TFW(DOI). 1
- (c) 27TRW(DOI). 1
- (d) 33TFW(DOI). 1
- (e) 35TFW(DOI). 1
- (f) 64TAW(DOI). 1
- (g) 67TRW(DOI). 1
- (h) 75TRW(DOI). 1
- (i) 316TAW(DOX) 1
- (j) 363TRW(DOI) 1
- (k) 464TFW(DOI) 1
- (l) 474TFW(DOI) 1
- (m) 516TAW(DOX) 1
- (n) 4403TFW(DOI). . . . 1
- (o) 58TAC FTR TNG WG. . 1
- (p) 354TFW(DOI) 1
- (q) 60MAWG(DOOXI) . . . 1

(4) TAC CENTERS, SCHOOLS
- (a) USAFTAWC(DRA) . . . 1
- (b) USAFTFWC(DRA) . . . 1
- (c) USAFAGOS(EDA) . . . 1

b. SAC

(1) HEADQUARTERS
- (a) DOX 1
- (b) XPX 1
- (c) DM. 1
- (d) IN. 1
- (e) NR. 1
- (f) HO. 1

(2) AIR FORCES
- (a) 2AF(INCS) 1
- (b) 8AF(DOA). 2
- (c) 15AF(INCE). 1

c. MAC

(1) HEADQUARTERS
- (a) DOI 1
- (b) DOO 1
- (c) CSEH. 1
- (d) MACOA 1

(2) MAC SERVICES
- (a) AWS(HO) 1
- (b) ARRS(XP). 1
- (c) ACGS(CGO) 1

d. ADC

(1) HEADQUARTERS
- (a) DO. 1
- (b) DOT 1
- (c) XPC 1

(2) AIR DIVISIONS
- (a) 25AD(DOI) 1
- (b) 23AD(DOI) 1
- (c) 20AD(DOI) 1

e. ATC
- (1) DOSPI 1

f. AFLC

(1) HEADQUARTERS
(a) XOX 1

g. AFSC

(1) HEADQUARTERS
(a) XRP 1
(b) XRLW. 1
(c) SAMSO(XRS). 1
(d) SDA 1
(e) HO. 1
(f) ASD(RWST) 1
(g) ESD(XR) 1
(h) RADC(DOTL). 1
(i) ADTC(CCN) 1
(j) ADTC(DLOSL) 1
(k) ESD(YW) 1
(l) AFATL(DL) 1

h. USAFSS

(1) HEADQUARTERS
(a) AFSCC(SUR). 2

(2) SUBORDINATE UNITS
(a) Eur Scty Rgn(OPD-P) . 1

i. USAFSO

(1) HEADQUARTERS
(a) CSH 1

j. PACAF

(1) HEADQUARTERS
(a) DP. 1
(b) IN. 1
(c) XP. 2
(d) CSH 1
(e) DOAD. 6
(f) DC. 1
(g) DM. 1

(2) AIR FORCES
(a) 5AF
1. CSH. 1
2. XP 1
3. DO 1
(b) Det 8, ASD(DOASD) 1
(c) 7AF
1. DO 1
2. IN 1
3. XP 1
4. DOCT 1
5. DOAC 2
(d) 13AF
1. CSH. 1
(e) 7/13AF(CHECO) . . 1

(3) AIR DIVISIONS
(a) 313AD(DOI). . . . 1
(b) 314AD(XOP). . . . 2
(c) 327AD
1. IN 1

(4) WINGS
- (a) 8TFW(DOEA) 1
- (b) 56SOW(WHD) 1
- (c) 366TFW(DO) 1
- (d) 399TFW(DO) 1
- (e) 405TFW(DOEA) 1
- (f) 432TRW(DOI). 1
- (g) 483TAC ALFT WG 1
- (h) 475TFW(DCO). 1
- (i) 1st Test Sq(A) 1

(5) OTHER UNITS
- (a) Task Force ALPHA(IN) . . 1
- (b) 504TASG(DO). 1
- (c) Air Force Advisory Gp. . 1

k. USAFE

(1) HEADQUARTERS
- (a) DOA. 1
- (b) DOLO 1
- (c) DOO. 1
- (d) XDC. 1

(2) AIR FORCES
- (a) 3AF(DO). 2
- (b) 16AF(DO) 1

(3) WINGS
- (a) 50TFW(DOA) 1
- (b) 20TFW(DOI) 1
- (c) 401TFW(DCOI) 1
- (d) 513TAW(DOI). 1

4. SEPARATE OPERATING AGENCIES
- a. ACIC(DOP). 2
- b. AFRES(XP). 2
- c. AU
  - 1. ACSC-SA 1
  - 2. AUL(SE)-69-108. . . . 2
  - 3. ASI(ASD-1). 1
  - 4. ASI(HOA). 2
- d. ANALYTIC SERVICES, INC . 1
- e. USAFA
  - 1. DFH 1
- f. AFAG(THAILAND) 1

5. MILITARY DEPARTMENTS, UNIFIED AND SPECIFIED COMMANDS, AND JOINT STAFFS

a. COMUSJAPAN 1
b. CINCPAC (SAG). 2
c. CINCPACFLT (Code 321). 1
d. COMUSKOREA (ATTN: J-3). 1
e. COMUSMACTHAI 1
f. COMUSMACV (TSCO) 1
g. COMUSTDC (J3). 1
h. USCINCEUR (ECJB) 1
i. CINCLANT (N31) 1
j. CHIEF, NAVAL OPERATIONS. 1
k. COMMANDANT, MARINE CORPS (ABQ) 1
l. CINCONAD (CHSV-M). 1
m. DEPARTMENT OF THE ARMY (TAGO). 1
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t. HQ ALLIED FORCES NORTHERN EUROPE (U.S. DOCUMENTS OFFICE) 1
u. USMACV (MACJO31) 1

6. SCHOOLS

a. Senior USAF Representative, National War College 1
b. Senior USAF Representative, Armed Forces Staff College 1
c. Senior USAF Rep, Industrial College of the Armed Forces. 1
d. Senior USAF Representative, Naval Amphibious School. 1
e. Senior USAF Rep, U.S. Marine Corps Education Center. 1
f. Senior USAF Representative, U.S. Naval War College 1
g. Senior USAF Representative, U.S. Army War College. 1
h. Senior USAF Rep, U.S. Army C&G Staff College 1
i. Senior USAF Representative, U.S. Army Infantry School. 1
j. Senior USAF Rep, U.S. Army JFK Center for Special Warfare. . . . 1
k. Senior USAF Representative, U.S. Army Field Artillery School . . 1
l. Senior USAF Representative, U.S. Liaison Office. 1

7. SPECIAL

a. The RAND Corporation 1
b. U.S. Air Attache, Vientiane. 1

TABLE OF CONTENTS

Page

APPENDIXES

FOOTNOTES

FIGURES Follows Page

FOREWORD

Beginning with a single C-47 "Gooneybird" in 1961, the USAF reconnaissance effort in Southeast Asia (SEA) has steadily expanded to keep pace with the increasing U.S. military role in the conflict. While the two previous CHECO reports on this subject examined USAF SEA tactical air reconnaissance from 1961 through June 1969, this report describes new equipment, technology, tactics, the relocation and deactivation of principal units, and the modernization of the VNAF aerial reconnaissance program. Although this report deals only with USAF efforts, the U.S. Army, U.S. Navy, and U.S. Marine forces have been important elements of tactical reconnaissance in SEA.

CHAPTER I

THE ORGANIZATION FOR RECONNAISSANCE IN SEA

Background - 1961-1969

Historically, reconnaissance forces are among the first units to engage in any war, and the conflict in Southeast Asia (SEA) was no exception to this experience. The USAF reconnaissance effort in SEA began in January 1961 when an SC-47 arrived at Vientiane, Laos to provide photo reconnaissance support for the U.S. Air Attache in that troubled land. After 38 "highly successful sorties", the SC-47 was shot down over the Plaine des Jarres on 24 March.[1/]

In the fall of 1961 increasing Communist activity in the Republic of Vietnam led to the dispatch of a Reconnaissance Task Force (RTF) consisting of four RF-101s and a Photo Processing Cell to Tan Son Nhut Airfield (Afld) under the code name PIPE STEM. The RTF was originally scheduled to remain for only eight days before returning to its home station at Kadena AB, Okinawa, but the need for photo reconnaissance was substantial and its stay was extended. Finally, on 21 November the PIPE STEM force departed for home. Significantly, the Photo Processing Cell remained behind.[2/]

In late November, another RTF, code name ABLE MABLE, landed at Don Muang Royal Thai Air Force Base (RTAFB) to support a growing requirement for photo reconnaissance over Laos. During its tenure, the ABLE MABLE force produced numerous significant intelligence items,

including photography of the Russian airlift into Laos in 1962. In December, the ABLE MABLE force moved again, this time to Tan Son Nhut Afld where it began flying in-country (within the boundaries of South Vietnam) intelligence collection missions. Eventually, the RF-101s of the ABLE MABLE task force, together with their parent unit, the 45th Tactical Reconnaissance Squadron (TRS) became part of the 460th Tactical Reconnaissance Wing (TRW) which was established at Tan Son Nhut Afld in February 1966.[3/]

Many of the early USAF tactical photo reconnaissance programs in SEA were still in existence in 1971. The most durable of all was the YANKEE TEAM Laotian reconnaissance program which began in May 1964 as part of the increased American support of Prince Souvanna Phouma. Initially the ABLE MABLE force at Tan Son Nhut Afld flew all YANKEE TEAM missions, but in September 1964 it was proposed that reconnaissance units be permanently stationed in Thailand so that missions could be flown over northern Laos without the need for air refueling. The request was forwarded through diplomatic channels to the Thai government which agreed to the request. Udorn RTAFB was chosen as the home station for the Thailand-based reconnaissance effort and in April and May 1964, the first RF-101s arrived. Eventually this modest force evolved into the 432 TRW whose establishment was formally approved by the Joint Chiefs of Staff in August 1966.[4/]

During 1966 a differentiated organizational structure for reconnaissance operations in SEA was created. In February, the 460 TRW was

established at Tan Son Nhut Afld. Four flying squadrons--the 16 TRS, the 20 TRS, Detachment 1 of the 45 TRS and Detachment 1 of the 460 TRW--were assigned to the Wing. Technical support for the Wing was furnished by the 13th Reconnaissance Technical Squadron (RTS) which eventually was to become the 12th Reconnaissance Intelligence Technical Squadron (RITS). In April, another major reorganization which reflected the greater American involvement in the conflict occurred when the Second Air Division was replaced by the reactivated Seventh Air Force (7AF) of World War II fame. The 360th, 361st, and 362d Tactical Electronic Warfare Squadrons (TEWS) were activated and in September were relieved from assignment to 7AF and reassigned to the 460 TRW, giving it both the photo and Airborne Radio Direction Finding (ARDF) reconnaissance missions. At the same time, all reconnaissance assets in Thailand--the 6460 TRS, the 6461 TRS, the 20 TRS, and the 41 TRS--were assigned to the new 432 TRW.

At the end of 1966, the SEA reconnaissance force had thus increased from four squadrons with three photo interpretation cells and three detachments to two full wings composed of two reconnaissance technical squadrons, eight flying squadrons, and three flying detachments. The number of reconnaissance aircraft increased from 67 to 143.[5/]

The rapid growth of the USAF reconnaissance fleet and the reorganization in 1966 did not resolve all the difficulties; indeed, new problems quickly emerged. It was apparent, for example, that in-country operations requirements differed sharply from those of the out-country (outside of

South Vietnam) war. From the beginning, the USAF had exercised mission control over all out-country aerial reconnaissance, although the Navy participated in the BLUE TREE and YANKEE TEAM* missions. However, the in-country reconnaissance effort evolved with multi-service rules. Four autonomous forces--the U.S. Army, U.S. Marines, U.S. Air Force, and the Vietnamese Air Force (VNAF)--were all participants in the in-country war. The paramount objective of all reconnaissance efforts was to provide intelligence as rapidly as possible to the users, but dissimilarities in the types of intelligence desired caused considerable coordination difficulties.

The several issues which arose in the process of achieving USAF-Army cooperation for the in-country reconnaissance effort have been examined in the previous CHECO Report Reconnaissance in SEASIA (July 1966-June 1969); to re-examine these issues here would serve no useful purpose. What is relevant is that a functional managerial system for in-country reconnaissance was developed. In March 1968, the Commander, U.S. Military Assistance Command, Vietnam, (COMUSMACV) designated the 7th AF Commander as Deputy COMUSMACV for Air Operations, to be the Single Manager of all tactical air resources in South Vietnam.[6/]

In some specialized segments of the SEA reconnaissance effort, such as the employment of national reconnaissance assets, divisions in mission

* U.S. reconnaissance missions flown over North Vietnam (BLUE TREE) and Laos (YANKEE TEAM).

authority remained. Visual reconnaissance (VR) was largely user-oriented, with each service satisfying most of its own requirements. Overall, however, the Single Manager system, in its control of aerial reconnaissance operations, worked well.

The Reconnaissance Organization in 1969

During 1969, the tactical reconnaissance force in SEA reached a plateau in its development. The number of aircraft in place stabilized. The RF-4Cs and EC-47s constituted the bulk of the force, with RB-57s, RF-101s, EB-66s, EC-121s, and EC-130s comprising the remainder. In-country operations emphasized visual and photo reconnaissance by day and infrared (IR) and photoflash operations at night. The EC-47-equipped TEW squadrons flew ARDF missions both during the day and at night, although sortie effort was concentrated on daylight missions because the enemy radio traffic tended to be heavier during those hours. Out-country operations employed a wide variety of aircraft including the EB-66s, RF-101s, EC-121s, EC-130s, RF-4Cs, and some national reconnaissance assets such as the U-2, SR-71, and photo-reconnaissance drones.

By 1970, the USAF reconnaissance forces in SEA had reached its peak strength. The 460 TRW at Tan Son Nhut had 37 RF-4Cs in two squadrons, one squadron of 17 RF-101s, a four-ship detachment of RB-57Es, and 45 EC-47s in three squadrons. The 432 TRW was a composite wing with 37 RF-4Cs in two squadrons, two F-4 squadrons of 34 aircraft for ordnance delivery, three EC-47s, and six C-130s which performed as the Airborne Battlefield Command and Control Center (ABCCC) aircraft.[7/]

Force Beddowns and Relocations: 1969-1970

From its peak, the reconnaissance force in SEA slowly declined in size. Innovative uses of sensors, such as the KA-82 cameras in RF-4Cs, lessened the impact of a decreased force.

The first force reduction was a minor one, but larger "drawdowns" were to follow. In July 1969, the 432 TRW's Airborne Radio Relay Squadron (HALFMOON) consisting of three EC-47s was deactivated.[8/] Then, in March 1970, the first major reduction in photo reconnaissance assets came when the 16 TRW relocated from Tan Son Nhut to Misawa AB, Japan.[9/] Subsequently in November, the 11 TRS deployed from Udorn RTAFB to Shaw AFB, South Carolina, taking its Photo Processing Interpretation Facility (PPIF) with it.

With the 11 TRS's departure, 7AF recommended to Headquarters Pacific Air Forces (PACAF) that the 432 RTS be deactivated. But PACAF disapproved the recommendation noting that "excessive courier time" would be required to fly the exposed aerial film to the only other available exploitation facilities which were located at Tan Son Nhut Airfield. PACAF also stated that as long as reconnaissance resources were based at Udorn RTAFB a mass reproduction and interpretation capability--i.e., the 432 RTS--would have to be maintained to provide support for Headquarters 7/13th AF, the Joint Liaison Detachment, Task Force Alpha, and other northern-based units.[10/] However, PACAF did approve a manning cut from 111 to 86 spaces for the 432 RTS, in recognition of the decreased workload.

ORGANIZATION OF USAF RECONNAISSANCE IN SEA

1969

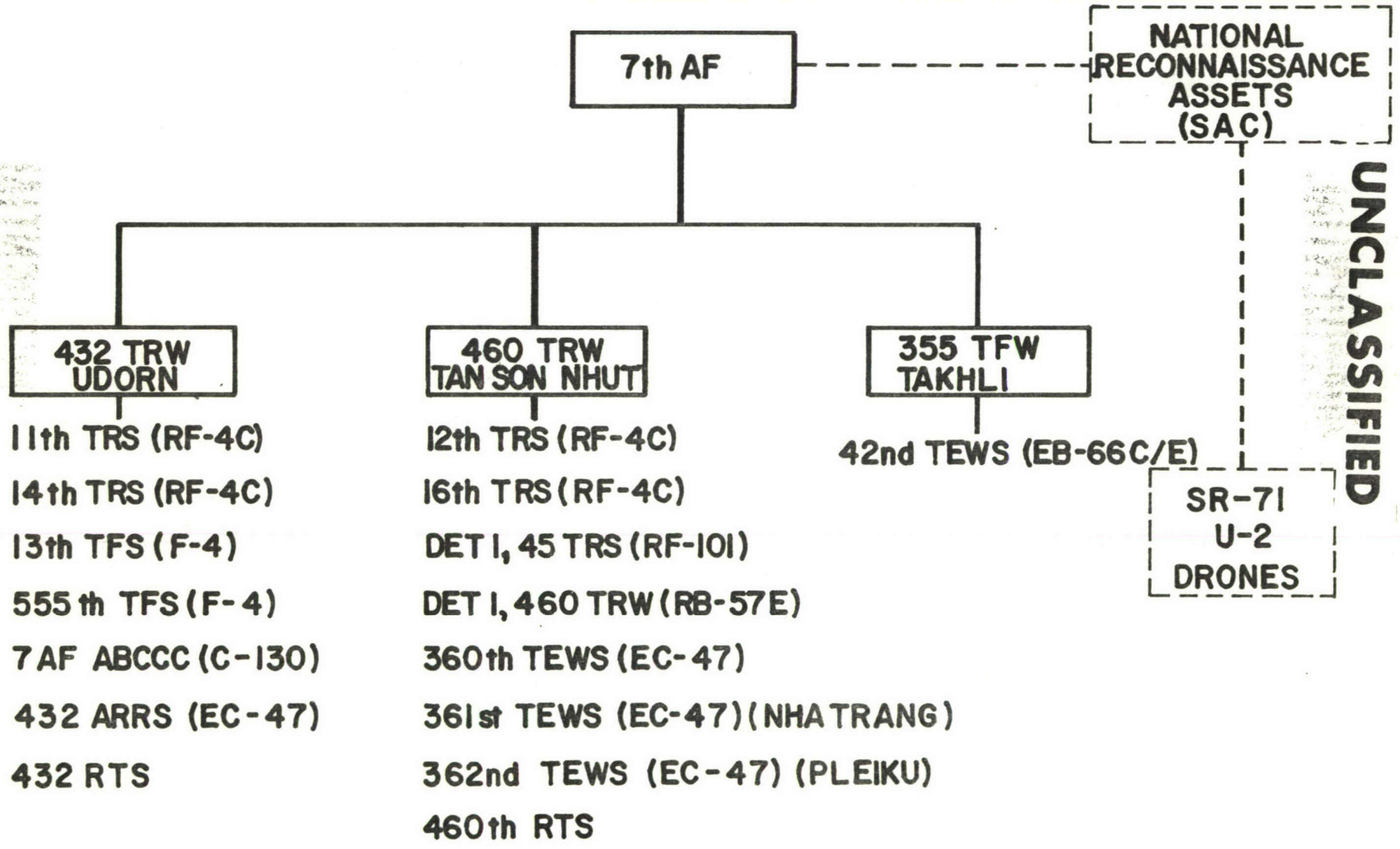

FIGURE 1

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The force reductions continued on into the fall of 1970. On 20 October, the 45 TRS ceased flying missions to prepare its RF-101s for redeployment. On 9 November, they began leaving Tan Son Nhut Afld for the Mississippi Air National Guard Base at Meridian, Mississippi. The departure of the 45 TRS marked the end of RF-101 reconnaissance squadrons in the Republic of Vietnam.[11/]

After the November cuts, the total tactical photo reconnaissance force in SEA stood at 43 percent of its pre-1970 size.[12/] The reductions also led to a 60 percent drop in the number of sorties allocated to in-country reconnaissance objectives. This fact was emphasized in a message sent by COMUSMACV to subordinate commanders regarding the need to conserve reconnaissance assets in the Republic of Vietnam. COMUSMACV directed that subordinate commands insure they used all available organic resources before submitting objectives to the USAF tactical reconnaissance system.[13/]

The electronic intelligence and electronic countermeasures force was also altered in the fall of 1970. The 42 TEWS relocated from Takhli RTAFB to Korat RTAFB on 30 September 1970 and became a part of the 388 TFW. In the relocation, six EB-66 aircraft (one EB-66C and five EB-66Es) were transferred to units within the United States. The major impact on SEA reconnaissance forces was the loss of the one EB-66C which was configured for gathering electronic intelligence.

A final relocation, amidst the other drawdowns and inactivations, was related to the ARDF/SIGINT (Signal Intelligence) missions. On 1 September 1969, the 361 TEWS and Detachment 1 of the 6994 Security Squadron (SS) relocated to Phu Cat AB from Nha Trang AB. The 362 TEWS and Detachment 2 of the 6994 SS also relocated on 19 June 1970 from Pleiku AB to Da Nang AB, leaving both units still in a position to cover their old operating areas. Programmed turnover of air bases to the Vietnamese armed forces during 1970 necessitated the relocation of the Tactical Electronic Warfare Squadrons (TEWS).

Thus by May 1971, the USAF tactical reconnaissance force in SEA was as follows:[14/]

Unit	Type Aircraft	Auth	Possessed	Location
Hq 432 TRW				
14 TRS	RF-4C	18	23	Udorn RTAFB
Hq 460 TRW				
Det 1	RB-57E	4	3	Tan Son Nhut Afld
12 TRS	RF-4C	18	17	Tan Son Nhut Afld
360 TEWS	EC-47	20	18	Tan Son Nhut Afld
361 TEWS	EC-47	19	16	Phu Cat AB
362 TEWS	EC-47	13	11	Da Nang AB
Det 1, 360 TEWS	EC-47	5	5	Nakhom Phanom RTAFB
42 TEWS	EB-66C/E	13	22*	Korat RTAFB

*The 42 TEWS was augmented with nine additional EB-66s in support of COMMANDO HUNT and LAM SON 719 Northeast Monsoon interdiction campaigns.

The Reconnaissance Cycle

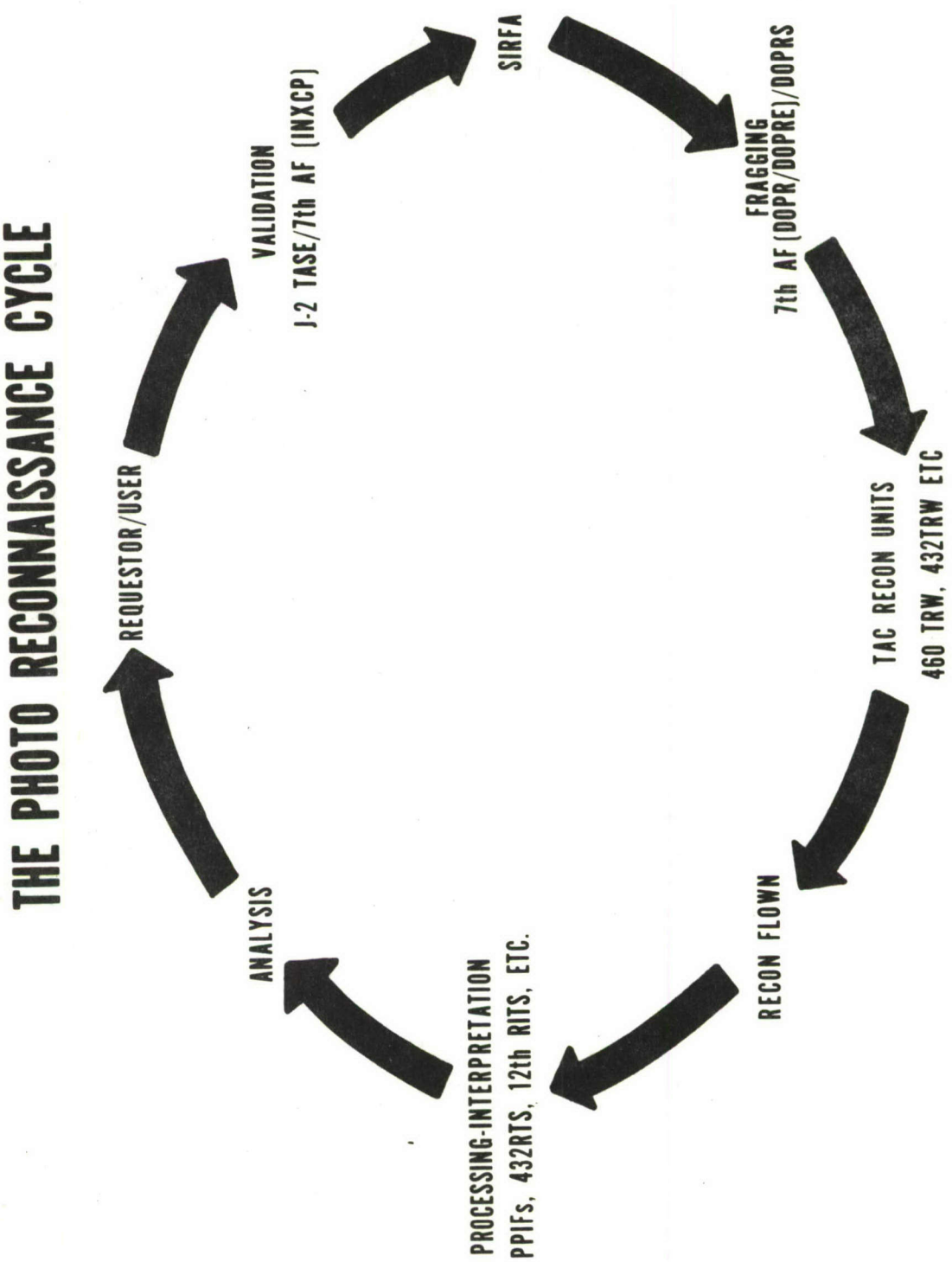
The focal point for tactical reconnaissance operations in SEA was 7AF Headquarters at Tan Son Nhut Airfield. Requests for reconnaissance support by field commanders were sent first to 7AF Deputy Chief of Staff (DCS) for Intelligence to be validated and assigned a target priority. (See Figure 2.) Validated targets were then entered into the computerized SEA Imagery Reconnaissance File-Automated (SIRFA). Daily retrievals from the SIRFA, called Auto-Frags, were made and supplied to the Reconnaissance/Electronic Warfare Division (DOPR) of 7AF DCS/Operations for preparation of mission tasking (Frag) messages. Within DOPR, target requests were broken down by the type of reconnaissance required: the Reconnaissance Branch scheduled all tactical photo reconnaissance missions; the Electronic Warfare Branch handled Electronic Intelligence (ELINT) collection requirements and requests for Electronic Countermeasures (ECM) support; and the Special Reconnaissance Branch handled all ARDF missions by publishing a daily fragmentary order, as tasked by MACV. The frag orders prepared by DOPR were then transmitted to the tactical reconnaissance units, which flew the missions.

One of the most significant advances in reconnaissance operations in the period covered by this report was the extensive use of computers to improve the speed and accuracy of the tactical reconnaissance management system. The primary management tool was the SIRFA, which was created in May 1969, with the introduction of an IBM 1410 computer format. Published on a weekly basis by 7AF DCS/Intelligence, the SIRFA provided

reconnaissance managers with a complete list of all target objectives. The SIRFA also listed the frequency of coverage required for each target, the sensor systems to be used, and outlined the distribution requirements for the photography. Inputs to the SIRFA data base were made in a variety of ways. Most were received via electrically transmitted message, others arrived via the 7AF Flight Operations (SCATBACK) courier system and, if the need were urgent, requests could be phoned in through the 7AF Command Post (BLUE CHIP). The prime objective was to get valid target requests into the SIRFA data base as quickly as possible. As a final check on the accuracy of SIRFA target objectives, DOPR manually checked the Auto-Frag, deleting targeting requirements which had been accomplished but had not been entered into the weekly listing.

The organization for processing and exploitation of SEA aerial photography generally reflected principles of the Tactical Reconnaissance Intelligence System Enhancement (TACRISE) program established by the U.S. Air Force in 1966. Essentially, the TACRISE concept called for three phases of photo exploitation with each phase being conducted by a separate facility. These facilities were to be the Photo Processing Interpretation Facility (PPIF); the Reconnaissance Technical Squadron (RTS) and the Reconnaissance Intelligence Technical Squadron (RITS).

The PPIFs were the heart of a "bare base" reconnaissance technical capability for the USAF. Trailerized and air transportable, the PPIFs were designed to be moved rapidly to new operating locations. Each PPIF



The Photo Reconnaissance Cycle

FIGURE 2

was equipped with six Versamat processors and the other photo lab equipment and exploitation equipment necessary to produce first-phase Immediate Photo Interpretation Reports (IPIRs) on the film exposed by the aircraft of the squadron to which they were assigned.

The second exploitation phase in the TACRISE system was the Reconnaissance Technical Squadron. Basically, the RTS was to be a more sophisticated reconnaissance technical support facility, designed to give a wing the capability to do in-depth imagery processing, interpretation, reproduction, and intelligence exploitation. The RTS was also to have facilities for mass duplication of film for external agencies and was to prepare second-phase Supplemental Photo Interpretation Reports (SUPIRs) on film forwarded by PPIFs. In short, the RTS was to be a more sophisticated technical support facility designed to support Wing-level reconnaissance requirements and, when necessary, provide backup support for the PPIFs.

The third stage in TACRISE was the Reconnaissance Intelligence Technical Squadron. The primary purpose of the RITS was to function as a command-level reconnaissance technical unit, responsive to the needs of the air component commander of a joint task force or unified command. The RITS was to possess the advanced equipment necessary to perform third-phase detailed readout of all reconnaissance film received from the tactical wings. The RITS was not intended for mobile operations.[15/]

In June 1971 there were four photo exploitation activities in SEA tasked with the responsibility of processing USAF reconnaissance film. At Udorn RTAFB, the 14 PPIF performed first-phase readout of film returned by the RF-4Cs of the 14 TRS. Second-phase SUPIRs were prepared by the nearby 432 RTS. In addition, the 432 RTS provided support for special Wing projects and provided technical support for Headquarters 7/13AF. Thus the Udorn reconnaissance organization was in accord with TACRISE concepts. However, the PPIF trailers were never used in the mobile support mode because the squadrons were not relocated.[16/]

At Tan Son Nhut Airfield in 1971, the reconnaissance organization departed from the TACRISE pattern in that there was no RTS.* The 12 PPIF generated first-phase IPIRs. Subsequent exploitation was done by the 12 RITS. Though the primary mission of the RITS was to provide technical support for 7AF, it also performed the SUPIR exploitation for the 460 TRW. Also, film from the 460 TRW's high-acuity KA-82 camera was rushed from the flight line directly to the 12 RITS for processing and was then returned to the PPIF for exploitation since the PPIF lacked the HTA-3 processors required to handle high resolution aerial film. Other functions performed by the 12 RITS included IPIR, SUPIR, and detailed photo exploitation of all BUFFALO HUNTER** drone missions, processing of

* The 460 RTS was located at Tan Son Nhut during 1969 but was deactivated on 31 March 1970.

** SAC drone photographic reconnaissance operations in SEA.

all color and camouflage detection (CD) film, and the production of photo interpretation keys and intelligence briefs. In all, the 12 RITS was a remarkably versatile and productive organization.

The multi-layer exploitation of aerial film required photo interpreters to read-out the same mission several times; however, the redundancy paid valuable dividends. Between 1 February and 30 April 1971, for example, large numbers of surface to air missile (SAM) "calls" were made at all levels in the exploitation cycle: 17/

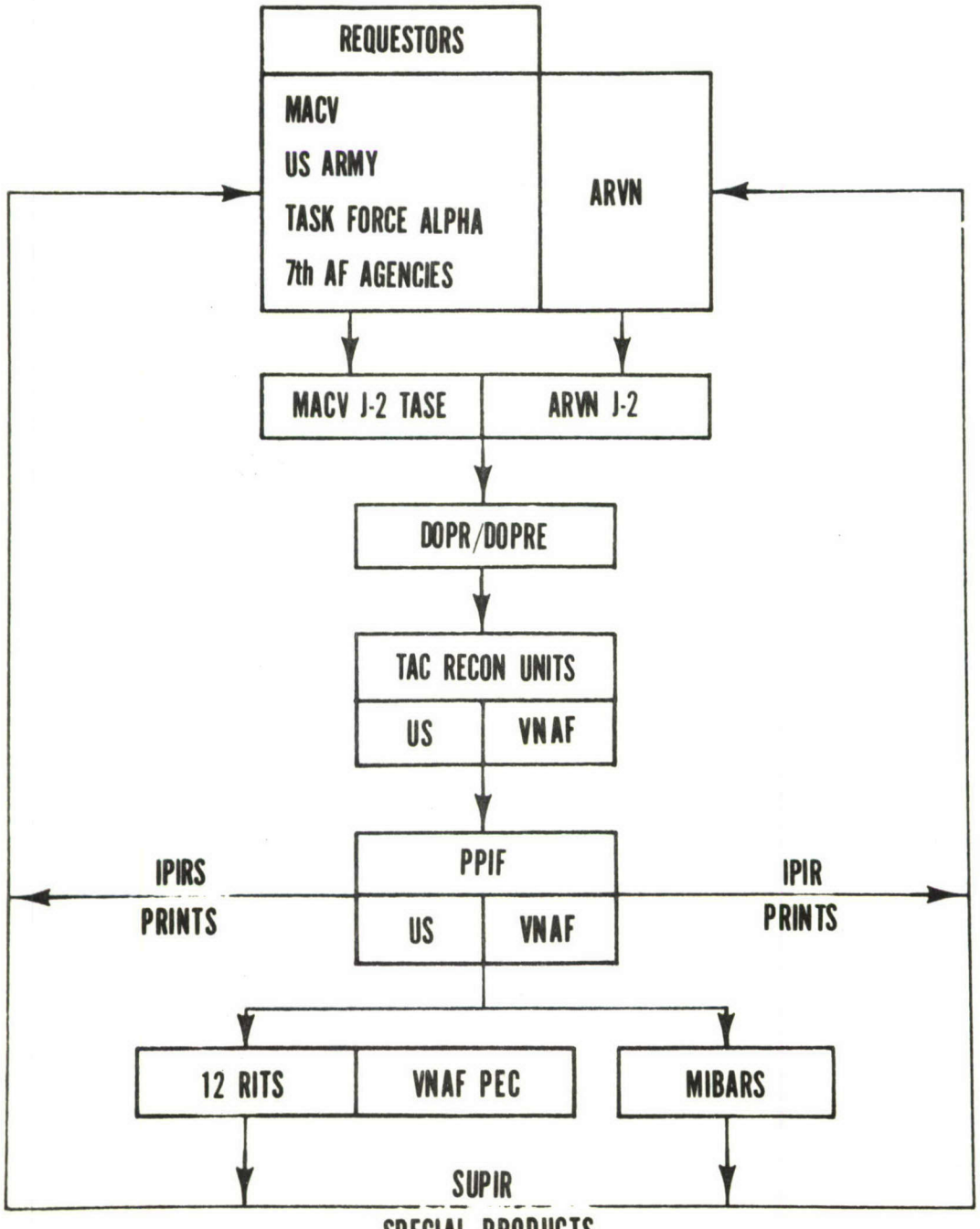
Agency Making SAM "Call"	Number of "Calls"	Percentage
12 TRS PPIF	17	12.1%
14 TRS PPIF	12	08.6%
432 RTS	18	12.9%
12 RITS	82	58.8%
MACV (CICV)	1	00.7%
NPIC	1	00.7%
PADAF	2	01.4%
Navy	3	02.1%
FICPACAFAC	1	00.7%
DIA	2	01.4%
	139	99.5%

The key to effective use of photo intelligence was rapid dissemination of all photo-interpretation reports to the users. Seventh Air Force operating

directives specified that all IPIRs were to be transmitted within 12 hours of the receipt of mission film by the PPIFs. SUPIRs were to be transmitted within 36 hours of the mission down time. A survey taken in August 1970 indicated that these deadlines were being met. The average time for 432 TRW-produced IPIRs was 10:30 hours from the time-over-target (TOT) to transmission of the IPIRs. Selected prints and mission film were forwarded to the 12 RITS from Udorn RTAFB via the Scatback courier system. Transit time varied with the availability of aircraft and the vagaries of SEA weather. At Tan Son Nhut, the 460 TRW required approximately 9:45 hours from TOT to the transmission of its IPIRs. Film from the Wing's PPIF arrived at the 12 RITS for second-phase exploitation approximately 30 minutes later.[18/]

The IPIRs, SUPIRs, and detailed photo interpretation reports were transmitted electrically. The methods of preparing reports for transmission varied with the facilities available to the individual units. PPIF-generated reports were handwritten, edited and then delivered to base communications centers for keypunching and insertion into the AUTODIN system. The 432 RTS and the 12 RITS keypunched their own reports and then edited them before they were sent to the communications center. The in-house keypunch capability usually resulted in fewer transmission errors. Dissemination of IPIRs, SUPIRs, and other photo-derived intelligence was virtually worldwide, with major air commands and national level agencies such as the Defense Intelligence Agency (DIA) receiving copies.

IN-COUNTRY RECONNAISSANCE CYCLE



The In-Country Reconnaissance Cycle

FIGURE 3

The COMPASS LINK Satellite Transmission System

The constraints placed on commanders in SEA made it necessary to keep high-level government officials and many national agencies well informed on the combat situation. Frequently this meant the forwarding of reconnaissance imagery to Washington, D. C. for use in making decisions on such items as strike targeting in politically sensitive areas; i.e., Cambodia and Laos.

Yet, prior to 1967, SEA commanders were forced to rely on the conventional courier system, which required many hours, or even days, to deliver high-interest imagery to agencies in Washington, D. C.

In July 1967, the transmission time for photo-imagery was cut from hours to a matter of minutes with the establishment of the COMPASS LINK satellite relay system. The basic COMPASS LINK equipment consisted of three 40-foot trailer vans; one sited at Tan Son Nhut, one in Hawaii, and one in Washington, D. C. In the Tan Son Nhut van, high priority reconnaissance imagery, up to 4.5 x 4.5 inches in size, was scanned by a laser light source. The light passing through the imagery was translated by a photomultiplier tube into an electronic signal which was then transmitted to a relay satellite over the Pacific Ocean. From the satellite, the signal passed to a second COMPASS LINK van in Hawaii, where it was reinforced and sent on to Washington, D. C. via a second relay satellite.

Using the COMPASS LINK system, high interest imagery, such as coverage of the weapons caches unearthed during the 1970 Cambodian incursion, were passed to decision-makers in a matter of minutes. The resolution of the transmitted photography was generally excellent, approaching an acuity of 30 lines per millimeter with up to 16 shades of gray under ideal conditions.[19/]

CHAPTER II

RECONNAISSANCE OPERATIONS

Operating Areas and Responsibilities

With minor exceptions, the operating areas for tactical reconnaissance forces in SEA have remained the same since November 1968. Since then, tactical reconnaissance has been conducted on a daily basis over South Vietnam, Cambodia, Laos, and specified areas of North Vietnam below the 19th parallel. Virtually all USAF photo reconnaissance in these areas was flown by either the 432 TRW or by the 460 TRW.

Mission tasking for photo reconnaissance of North Vietnam was divided between 7AF units the U.S. Navy's Task Force 77, and the Strategic Air Command. Seventh Air Force conducted all tactical photo reconnaissance in Route Package (RP) 1, Task Force 77 had the responsibility for RP 2 and 3 up to the 19th parallel, and national reconnaissance vehicles under SAC control performed all photo coverage above 19 degrees north.[20/]

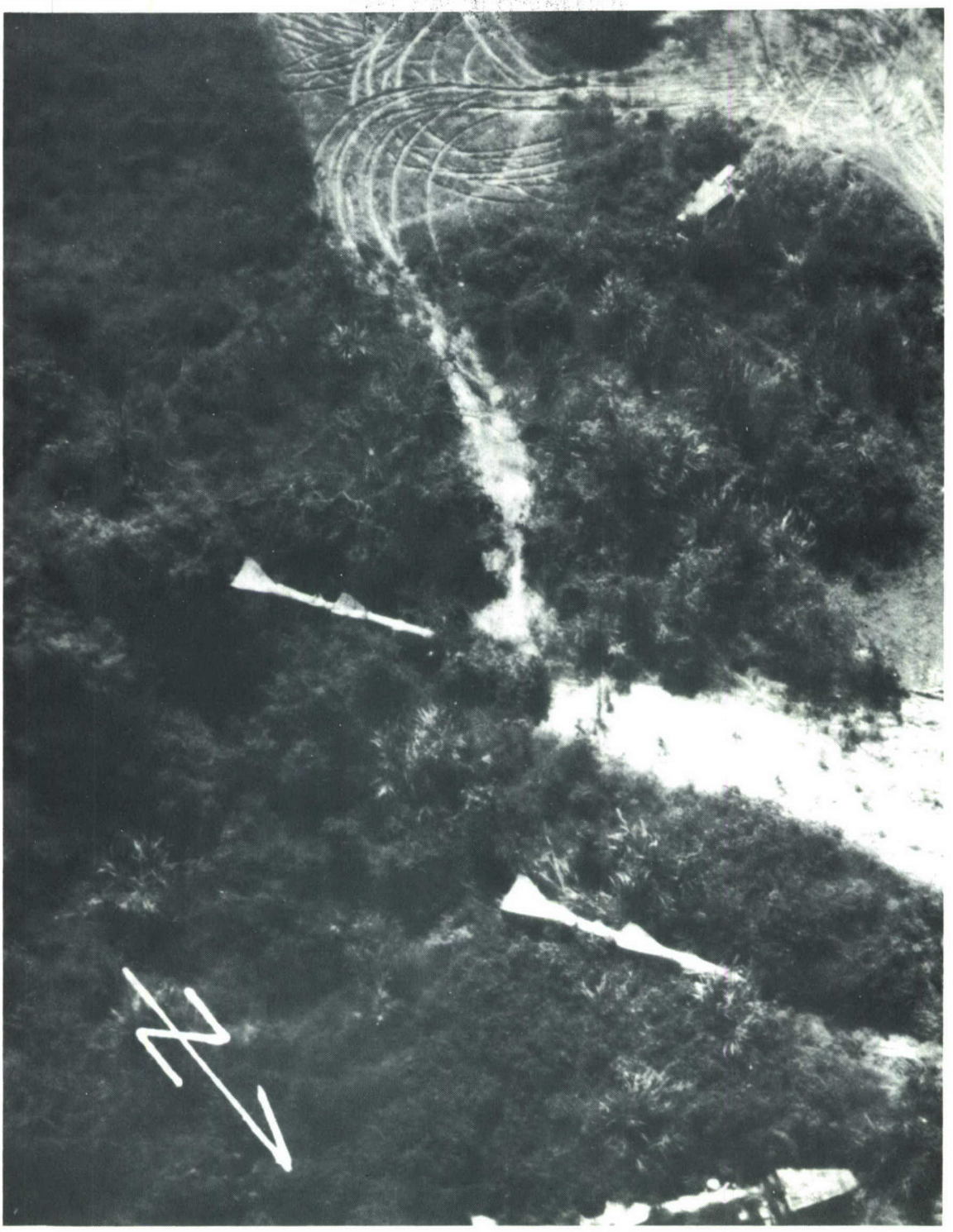
The primary purpose of reconnaissance over the North Vietnam (NVN) was to monitor the strength and disposition of the enemy's forces. During most of 1970 and 1971, SAM* sites were prime reconnaissance objectives. Daily coverage of the major RP 1

*Surface-to-Air Missiles

route structure within 25 nautical miles of the Laos border was attempted to watch for signs that the enemy might be moving his SAMs or heavy anti-aircraft guns into positions along the border where they might threaten tactical air and B-52 operations in Laos.[21/]

A wide variety of vehicles was employed to cover the NVN. North of the 19th parallel, where manned tactical photo reconnaissance was restricted from operating due to political constraints, strategic reconnaissance vehicles were used. GIANT SCALE SR-71s used their infrared (IR), Side Looking Airborne Radar (SLAR) and conventional cameras to cover the Hanoi-Haiphong area on a regular basis and also keep watch on SAM movements throughout NVN. On occasion the SR-71s also collected electronic intelligence along the periphery of Communist China.[22/]

BUFFALO HUNTER drones and manned tactical systems provided coverage of the lower areas of NVN, with the drones also providing high and low level photo reconnaissance in the northern sections. Most USAF tactical reconnaissance in this area was performed by the 432 TRW. The Wing's Udorn location put it closer to RP 1 than any other USAF photo reconnaissance unit. RF-4Cs from the 432 TRW could stay on target in RP 1 for nearly 30 minutes without aerial refueling. A second factor in the decision to task the 432 TRW with primary responsibility was its unique mix of fighter and photo aircraft, which was the ideal combination for operations in RP 1, where armed escort of all photo aircraft was required. The use of 432 TRW fighters and reconnaissance aircraft



Photograph taken on 20 Feb 70 at 500 feet by a KS-72 camera showing SA-2 missiles and associated equipment parked in a support area in North Viet Nam's Route Pack I.

FIGURE 4

permitted continuity in combat crew briefings and an exchange of tactics information on a crew-to-crew basis.[23]

Other reconnaissance vehicles operating against targets in the panhandle of NVN included the Army's OV-1 Mohawks, which flew both IR and SLAR missions along the coast from their base at Hue-Phu Bai. Also, EB-66s of the 42 TEWS at Korat flew ELINT missions in the region. Finally, SAC's COMBAT APPLE RC-135Ms had several tracks/orbits in the Gulf of Tonkin which gathered valuable COMINT and ELINT data.[24]

In Laos, the primary mission of tactical reconnaissance was to support the interdiction campaign. Support was also provided to friendly ground forces such as Meo General Vang Pao's guerilla units operating in the Plaine des Jarres region. Reconnaissance support for the interdiction effort consisted principally of coverage of the enemy's constantly expanding logistics routes in southern Laos. The 432 TRW conducted daily route searches to determine road status and to locate truck parks, bivouacs, and storage areas for strike target development.

Because of its proximity to Laos, the 432 TRW had the primary responsibility for photo reconnaissance in that area. On occasion the 460 TRW also operated in Laos, but most of its missions were in the southern panhandle. In addition to photo reconnaissance, EB-66Cs patrolled Laos watching for enemy fire control radar. The EB-66 sorties were supplemented by SAC's COMBAT APPLE aircraft which flew

over Laos regularly. Finally, Army OV-1s roamed the STEEL TIGER and BARREL ROLL areas during the night hours gathering valuable intelligence with their IR and SLAR sensors.[25/]

Photo reconnaissance in Cambodia became the sole responsibility of the 460 TRW in September 1970 because the Tan Son Nhut-based aircraft could remain on station 45 minutes as opposed to only 10 minutes for unrefueled Udorn aircraft. A second reason for giving the Cambodian mission responsibility to the 460 TRW was the sensitive nature of the job. As a 7AF study noted: "Units close to the Commander (in-country) were considered the better asset from the standpoint of strict command, control and response."[26/]

The USAF tactical reconnaissance effort in South Vietnam continued to show a marked decline from earlier years, reflecting the Vietnamization of in-country reconnaissance and also a significant reduction in enemy activity, especially in Military Regions (MR) 3 and 4. During the first six months of 1971, there were only 688 photo and IR reconnaissance sorties, as opposed to 4,430 in the same period a year earlier.[27/] The 460 TRW had primary mission responsibility, although by July 1971, aircraft of the 432 TRW were flying night IR missions in the MR 1 area as the 460 TRW prepared to stand down from operations.

Last, but certainly not least, were the ubiquitous Forward Air Controllers (FACs). They performed visual reconnaissance in South Vietnam, Cambodia, and Laos. The FACs were important elements in the

interdiction and close support operations.[28] As COMUSMACV noted:

> *The FACs deserve a special word. In the Republic of Vietnam, STEEL TIGER and BARREL ROLL there are FACs flying all types of aircraft to match the environment and these are very important. For sensitive areas such as the borders of Cambodia and Laos, you're not in the ball game unless a FAC is there. He makes sure you're doing what is authorized and not guessing. He takes the guess work out of the operation. They've made a real professional contribution, because they are seasoned professionals.*

The Enemy Air Defense Threat

The enemy's ability to put up an effective air defense was a deciding factor in determining how and where U.S. tactical reconnaissance forces were employed in SEA. In defending against tactical air and aerial reconnaissance operations, the enemy relied on a "troika" of weaponry, which included SA-2 "Guideline" missiles, MIG-interceptors, and conventional anti-aircraft guns. During the period covered by this report, the quantity of all three weapons systems increased markedly.

The MIG threat to reconnaissance operations was limited primarily to the air over North Vietnam itself and was especially concentrated around Hanoi and Haiphong. By June 1971 the air order of battle for North Vietnam included 88 MIG-21 interceptors and a total of 88 MIG-15s, 17s, and 19s. This represented a sharp increase in the NVN air force, which two years earlier possessed 36 MIG-21s and 40 earlier model fighters.[29] In 1971 the North Vietnamese had a number of airfields

capable of supporting jet fighter operations, including one as far south as Vinh. (There was also an unconfirmed suspicion within the intelligence community that the Communists might be considering reopening air operations at Dong Hoi Airfield). Although no tactical reconnaissance aircraft were lost to MIGs in 1970 or the first six months of 1971, the enemy interceptors were showing greater aggressiveness. In 1971, FACs operating in Laos reported three unsuccessful attacks by MIG aircraft.

Another element in the enemy's air defense system was the SA-2 surface-to-air missile. Since its introduction in 1965, the North Vietnamese had steadily expanded the areas covered by their SAM defense network. By 1971, SA-2s were operational from the Hanoi-Haiphong area down to the southern panhandle, overlapping at times into the DMZ and adjacent areas of Laos. The threat to air operations over Laos reached a high point during the 1970-71 dry season. Throughout the Lam Son 719 campaign (the South Vietnamese incursion into Laos in 1971) tactical reconnaissance units conducted an intensive SAM search operation in an effort to provide warning and protection for strike forces supporting the Army of the Republic of Vietnam (ARVN) forces.* 30/ Although no tactical reconnaissance aircraft were lost to SAM fire during the period of this report, there were many firings at reconnaissance aircraft and their armed escorts. On 22 March 1971, an F-4 escorting a photo aircraft in Route Pack 1 was downed by a SAM,

*New SAM sites were located in the Mu Gia, Ban Karai, and Barthelemy Pass areas.

prompting a major review of the protective measures for reconnaissance missions over North Vietnam.[31/]

The third component of the enemy's air defense system was his vast arsenal of highly mobile anti-aircraft weapons. In North Vietnam and in Laos these weapons included all calibers from 12.7mm automatic weapons up to 100mm heavy anti-aircraft cannon with radar fire control systems. Enemy anti-aircraft artillery (AAA) reactions to tactical photo missions were sporadic. The only trend established was that low level flights were more likely to provoke a reaction than were medium altitude passes.[32/] Taken together, the SAM, MIG, and AAA threat in North Vietnam constituted a defensive system far more deadly than anything encountered by American aviators over Germany in World War II.

Outside of North Vietnam, the heaviest ground fire threats were in the BARREL ROLL area of Northern Laos and the areas around Tchepone in the southern panhandle. Enemy anti-aircraft guns in these areas possessed a radar fire control capability but the actual use of radar was relatively rare.[33/] A less intensive AAA threat also existed in parts of Cambodia and high threat areas within South Vietnam as well. Especially worrisome was the Soviet-made 23mm anti-aircraft gun, which could throw up a curtain of effective fire to nearly 8,200 feet. Compounding the entire AAA problem was the enemy's skill in camouflaging his sites and his practice of rapidly and frequently relocating his weapons.

Reconnaissance losses to enemy fire from January 1970 through May 1971 were as follows:[34]

Aircraft Type	IN-COUNTRY MR 1	MR 2	MR 3	MR 4	Camb	OUT-COUNTRY ST	BR	NVN	Total
O-1	0	3	0	1	1	0	0	0	5
O-2	6	2	0	0	3	3	0	0	14
OV-10	1	1	2	0	5	6	2	0	17
RF-4C	2	0	1	0	0	4	2	0	9
EC-47	0	1	0	0	0	1	0	0	2
EB-66	0	0	0	0	0	0	0	0	0
									47

The American response to the enemy's air defense threat took a variety of forms. In the area of North Vietnam above the 19th parallel, SR-71s were employed due mainly to political considerations. In the lower route package areas, manned reconnaissance aircraft were supplemented by photo reconnaissance drones which were able to fly in under low cloud layers and photograph heavily defended areas.[35]

As a result of the increasing threat from enemy ground fire in 1970, the slower and more vulnerable RB-57s were withdrawn from the high threat areas in Laos and North Vietnam and were assigned to cover targets in the relatively more permissive environments of Cambodia, southern Laos, and South Vietnam. In addition, the RB-57 was restricted to flying daylight missions because of its inadequate navigational equipment.[36]

Other measures to reduce risk included the use of oblique cameras to survey high threat areas, acceptance of less than 100 percent coverage on winding road strips, avoidance of multiple passes over adjacent target areas, limitations on the number of photoflash cartridges expended on a single pass at night, and the use of varying speeds and vertical and horizontal "jinking" prior to the time when straight and level flight was necessary for the actual photo run.[37/] Another tactic to discourage enemy firings was the publicly announced U.S. policy of "protective reaction" strikes against enemy AAA sites in North Vietnam known to have fired at reconnaissance aircraft. A final tactic employed by reconnaissance managers to degrade the ground fire threat was the establishment of a 4,500 foot absolute altitude as the minimum operating altitude for all photo reconnaissance missions in North Vietnam, Laos, and Cambodia.

The use of armed escorts for reconnaissance missions over North Vietnam continued to be routine. F-4s from the 432 TRW, and occasionally the 366 TFW, escourted RF-4Cs into RP I, for protective retaliation in the event of enemy reaction to the reconnaissance overflight. In addition, they provided MIG protection and added an increased ECM jamming capability against SAMs and radar directed AAA.

The establishment of the 4,500 foot minimum altitude for photo reconnaissance aircraft was done at the expense of the effectiveness of several sensor systems. This led to increased use of longer focal-length cameras such as the 18 inch splitvertical KS-72s. In addition,

the KA82 with its high definition could provide excellent area coverage and good acuity at altitudes above the 4,500 foot minimum.

The continued effectiveness of the SEA reconnaissance effort in the face of a steadily growing ground fire threat was proof of the resourcefulness of the reconnaissance managers and the courage of the aircrews. Clearly, however, the SEA experience underscored the need for new sensor systems better adapted to the high speed, medium altitude, and strenuous evasive tactics necessary for reconnaissance aircraft to survive in high threat areas.

Enemy Camouflage Techniques

The enemy forces in SEA continued to practice the excellent camouflage discipline that has been a trademark of their operations since the days of the French presence in Indochina. At one time or another, the Communists used virtually every conceivable technique to hide their activities from aerial surveillance. The enemy also attempted on occasion to deceive aerial reconnaissance as to his strength and dispositions. A classic example of such deception occurred in December 1969 when an RF-4C of the 432 TRW photographed what appeared to be a four-position heavy caliber anti-aircraft artillery site. Closer examination by photo interpreters using stereo viewers revealed that the guns were actually logs. Deceptive actions like this have in the past sometimes led to the expenditure of weapons on dummy sites and have even lured Free World aircraft into cleverly-laid flak traps.[38/]

The enemy's skill at camouflaging his weapons also led to some radical departures from the deployment patterns normally associated with Communist-bloc equipment. The classic configuration for the SA-2 "Guideline" missile, for example, is six launchers positioned in a circle around a central fire-control radar (See Figure 5). With minor variations this pattern appears in virtually every Communist nation in the world. Student photo interpreters at the Armed Forces Air Intelligence Training Center (AFAITC) at Lowry AFB, Colorado are drilled in these conventional patterns. Upon arrival in SEA, however, they discover that all the "rules" are broken and they must become familiar with different missile deployment practices.

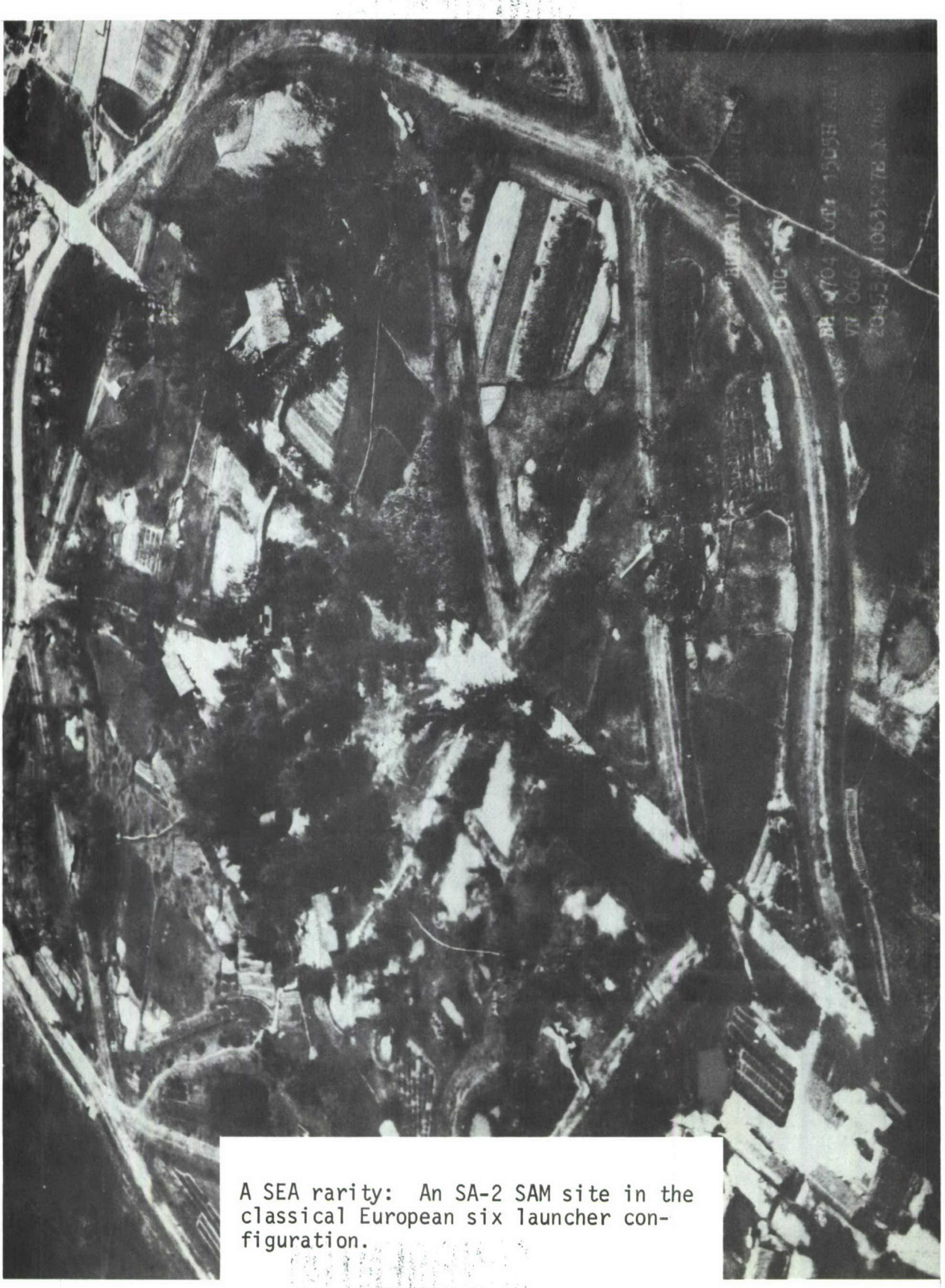
An example of the enemy's unorthodox siting procedures was the Ban Karai SAM site located along the Laos-North Vietnam border. The standard six-launcher configuration was replaced by three launchers. Both the missiles and the associated radars were located on the hillside in a manner that precluded a 360 degree field of fire. Nonetheless, the siting was effective since it provided coverage of the western and southern quadrants, the directions from which U.S. strike aircraft including B-52s would be most likely to appear as they flew in support of the Lam Son 719 operation.

As the pictures on the following pages show, the skillful use of natural cover prevented discovery of the Ban Karai site for more than a week (See Figures 6, 7 and 8). The site was not detected until

28 February 1971 when a radar bearing obtained by a COMBAT APPLE reconnaissance sortie sent photo interpreters back to their film. A careful review of GIANT SCALE SR-71 photography then revealed that the site had been in existence for at least eight days prior to its detection by the ELINT aircraft.[39] Yet the Ban Karai episode was not atypical of the SEA experience. Nor was it necessarily a failure of photo intelligence. Instead, it clearly underscored the handicaps under which photo intelligence labored in SEA. Photo reconnaissance could not and cannot be the universal detector of all enemy activity unassisted by other intelligence data.

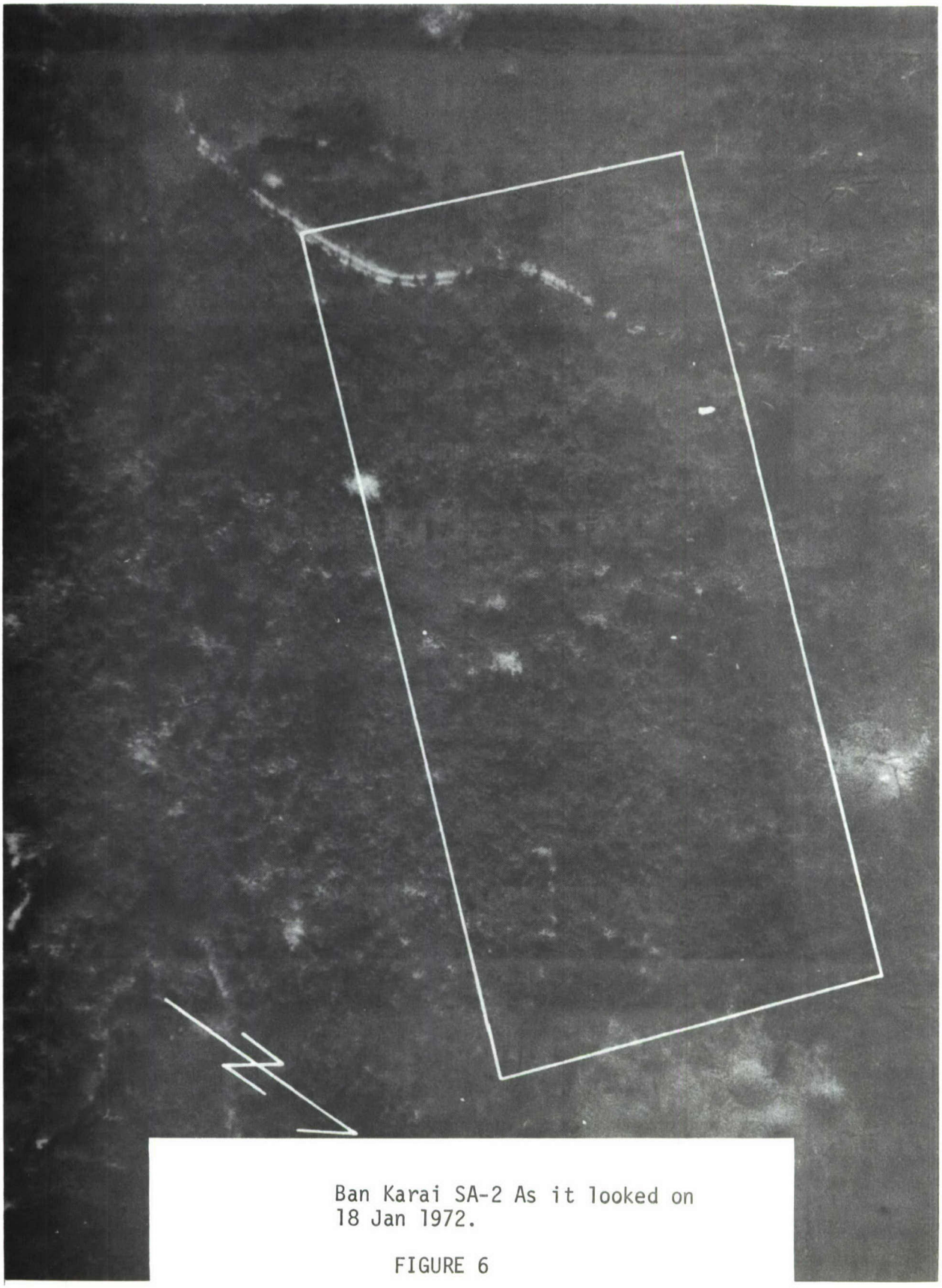
Weather, Night, and Haze: Their Impact on SEA Reconnaissance

In addition to the enemy threats, the reconnaissance effort in SEA also had to cope with formidable natural phenomena, the foremost of which was weather. In effect, Free World Forces in SEA fought two different wars each year. During the northeast monsoon season (dry season), which usually began in October, enemy infiltration and logistics movement reached its peak. Air operations against this activity soared and occasionally there were not enough reconnaissance resources available to cover all the desired objectives. Then, in April, the winds changed and the southwest monsoon (wet season) began. During the wet season, reconnaissance, like all other facets of tactical air operations, was severely limited by the stormy weather which caused sortie rates to fall off.[40] As the COMMANDO HUNT V report commented:[41]



A SEA rarity: An SA-2 SAM site in the classical European six launcher configuration.

FIGURE 5



Ban Karai SA-2 As it looked on
18 Jan 1972.

FIGURE 6

inch framed format. The F-415Y carried up to 1,800 feet of Eastman Kodak 3401 thin-base aerial film.[82]

The high altitude photo reconnaissance drone carried the HR-338 Sensor system. This was a 24-inch focal length camera producing a framed format of approximately 9 x 9 inches. The optics were mounted in an oblique head and lens cone which swept in an arc across the flight path. Exposures were made at five positions on the arc, thus providing near horizon-to-horizon coverage. The camera could be loaded with 1,500 feet of Eastman Kodak 3400 or 3401 thin-base film. Resolution with this lens/film combination was approximately 50 lines per millimeter. Photography taken at the drone's normal operating altitude permitted objects approximately 10 feet on a side to be discriminated.[83]

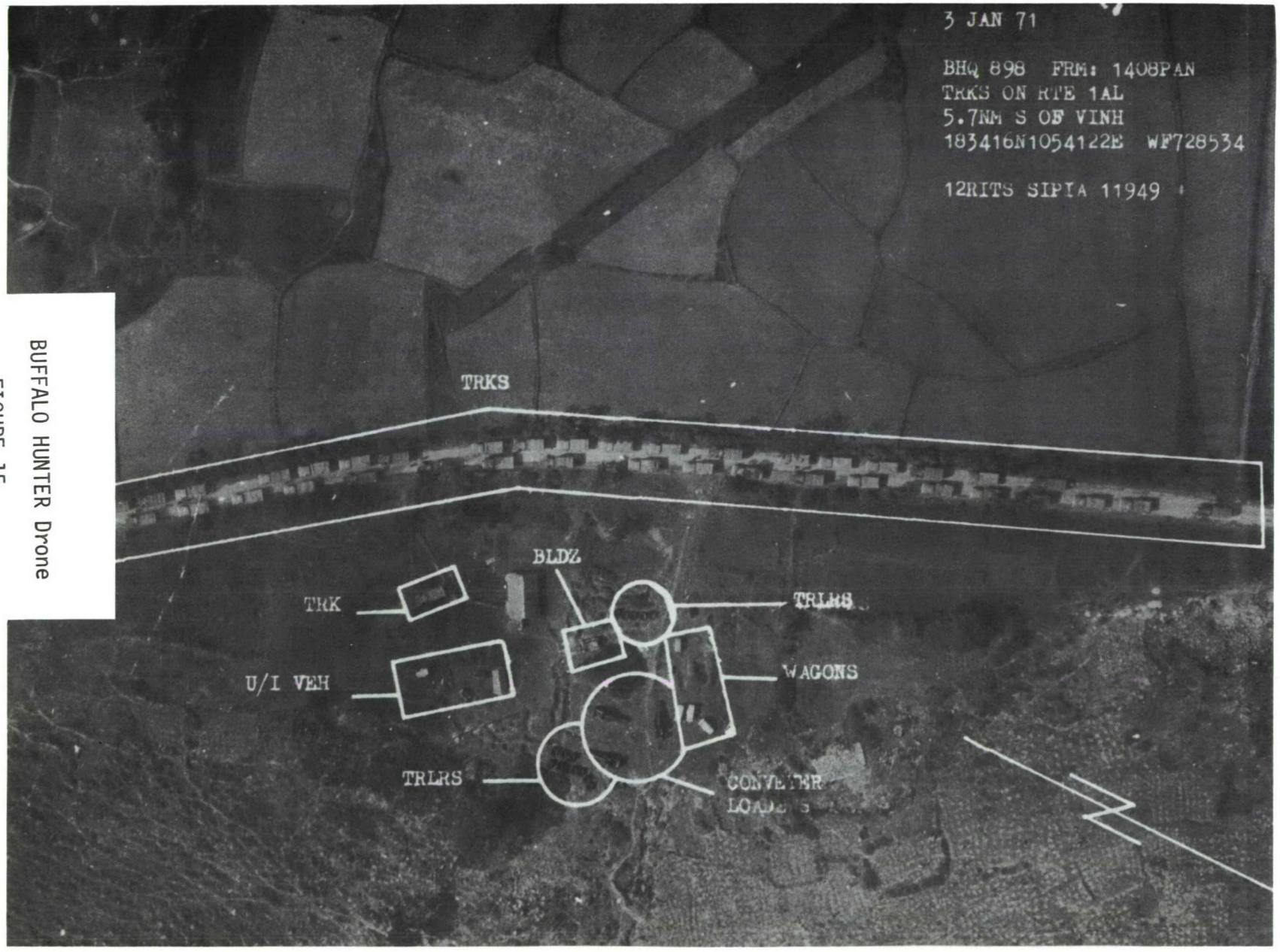
Drone Operations

Drone reconnaissance in Southeast Asia was conducted by the Strategic Air Command since the missions were oriented primarily towards fulfilling national reconnaissance objectives.[84] Actual field operations were conducted by a unit of the 100th Strategic Reconnaissance Wing at U-Tapao RTAFB under the nickname BUFFALO HUNTER (formerly BUMBLE BUG and BUMPY ACTION). Launch operations moved to U-Tapao RTAFB from Bien Hoa AB, RVN in April 1970 when Vietnamese Air Force (VNAF) expansion reduced ramp space at the latter base.[85] Drone missions were scheduled and mission track profiles prepared by the SAC Reconnaissance Center (SACRECONCEN) at Offutt AFB, Nebraska in response to tactical requirements from 7AF and MACV.[86]

The launch platform for the reconnaissance drones was a specially configured DC-130. Two of the DC-130s were configured to carry four drones externally, while the remainder carried two each. Spare drones were kept in varying stages of readiness at the launch site at U-Tapao. Drones were air-launched from the parent aircraft and normally flew along a pre-programmed track using only internal navigation systems. Controllers in the mother ship monitored the drone's guidance system in case the vehicle departed from the desired track.[87]

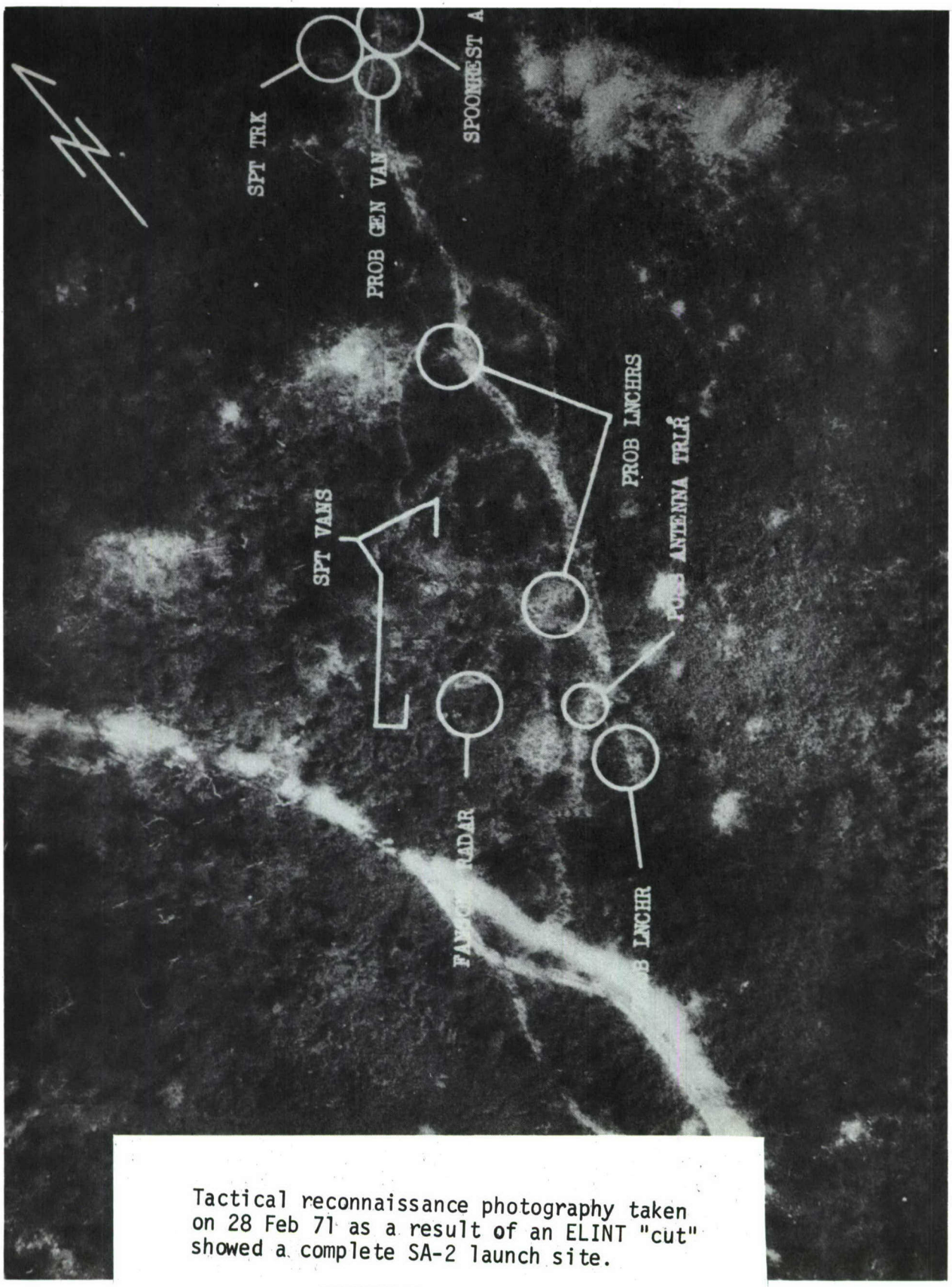
Flight profiles varied with the model of drone being used and the mission. In the low altitude mode, the drone was air-launched and descended before beginning its target run. Usually a drone would make runs over several target areas before turning toward the recovery area. The high-altitude drone climbed from its launch point to a 50,000 foot-plus cruising altitude, covered its target areas and then proceeded to the recovery zone.

The actual recovery of drones occurred near Da Nang Air Base, RVN. As the drone neared the designated recovery point its engine shut down and a parachute system deployed. Waiting at approximately 10,000 feet was a CH-3 helicopter equipped for mid-air recoveries. The CH-3 snagged the descending drone and ferried it to Da Nang for downloading of the film. (See Figure 18.) In 1970, approximately 98 percent of all returning drones were successfully recovered in this manner,[88] although surface retrieval was occasionally necessary. (See Figure 17.)



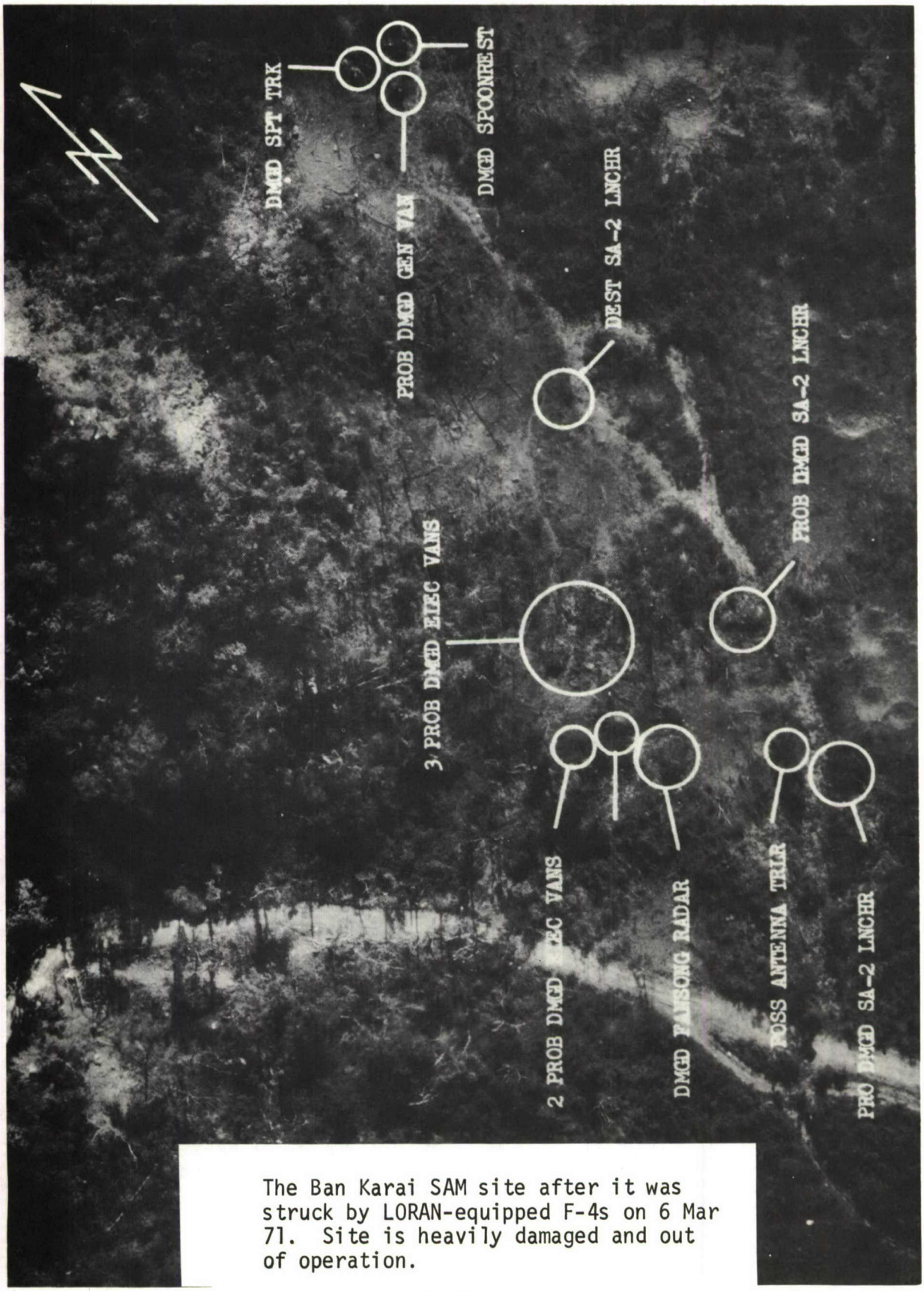
BUFFALO HUNTER Drone

FIGURE 15



Tactical reconnaissance photography taken on 28 Feb 71 as a result of an ELINT "cut" showed a complete SA-2 launch site.

FIGURE 7



The Ban Karai SAM site after it was struck by LORAN-equipped F-4s on 6 Mar 71. Site is heavily damaged and out of operation.

FIGURE 8

Weather played a key role in the photo-reconnaissance operations in SEA. The weather from RP 1 to the western slopes of the Annamite Mountains was often unsuitable for photo reconnaissance. All photo reconnaissance targets associated with the entry interdiction program were in the poor weather areas. All NVN defense sites threatening US air operations in Steel Tiger were also in this area. The ends of the major throughput routes to the RVN, Routes 926, 922 and 966, and their extensions in MR 1 also were in areas of poor weather.

Considerable reconnaissance resources were expended in marginally successful or unsuccessful attempts to photograph important targets in the poor weather areas.

The heavy cloud layers associated with the southwest monsoon season played havoc with reconnaissance flight operations. Aircraft flying at the 4,500 foot above ground level (AGL) minimum altitude frequently found themselves unable to see their targets because of the heavy undercast. Yet aircraft attempting to reach their targets by flying under the cloud banks usually were within range of enemy automatic weapons and anti-aircraft fire. There was no ready solution to the wet season weather. All-weather sensors simply did not exist. The enemy continued to move (although the weather adversely affected his operations too) and so reconnaissance missions had to be flown even when the chances of successful photo coverage were, at best, marginal.

In addition to its negative effect on flight operations, weather also seriously degraded the effectiveness of several key reconnaissance sensor systems. The AN/AAS-18 infrared (IR) sensor in the RF-4C was

particularly hard hit as the short-lived Vehicular Intelligence Gained from Infrared and LORAN (VIGIL) program revealed. Between January and April 1971, the 432 TRW attempted to locate enemy truck parks and staging areas in Laos by using the RF-4Cs' IR sensors in conjunction with "tipoff" data gathered from ground sensors by Task Force Alpha. Heavy moisture in the air degraded the already marginal resolution capabilities of the AN/AAS-18 system and, in many cases, rendered it completely useless. On 28 March, for example, a VIGIL (IR) mission completely failed to detect a truck park that was positively identified by an ATLANTA quick-reaction reconnaissance mission the following day.[42/] On 17 April the VIGIL program was permanently discontinued in recognition of the severe IR sensor degradation caused by the rain, haze, and fog of the wet season.

Moisture in the air was not the only factor affecting IR missions in SEA. In hilly and mountainous terrain, such as in Laos, the ability of IR to discriminate between vehicles, such as tanks and trucks, was "virtually nil" at safe operational altitudes. As a 7AF study noted, IR imagery flown at an altitude of 1,500 feet AGL was "marginal" and at 2,000 feet the imagery produced was of "little value".[43/] In late 1969, the 460 TRW experienced similar problems as it attempted to fly IR missions in response to COVEY FAC requests. The heavy tree canopy, combined with the high moisture content of the air, frequently blocked IR radiations. It was thus not surprising that the number of IR missions declined from 1,733 in the first half of 1970 to only 834 during the same period in 1971.

The need for improved IR sensor systems has been recognized by reconnaissance managers. The SEA Operational Requirement Number 92 and PACAF Required Operational Capability Number 37-69 stated an urgent need for improved IR sensors for the RF-4C. In July 1971 the Honeywell-developed AN/AAD/5 was scheduled to begin category I, II, and III testing. It was hoped that when developed, the AN/AAD/5 would prove less susceptible to SEA climatic conditions; meanwhile, the rainy weather of the wet season made IR reconnaissance futile.

A final atmospheric problem which hampered aerial reconnaissance resulted from the traditional "slash and burn" technique used by farmers in Laos to clear land for cultivation. In stable air conditions, the smoke which was generated so obscured the terrain that photographic and visual reconnaissance was often fruitless. Toward the end of 1970, the 432 TRW, which conducted both photo and VR reconnaissance in Laos, reported that "slash and burn" activities had produced so much smoke and haze that even visual navigation was difficult unless flown at very low altitudes.[44/]

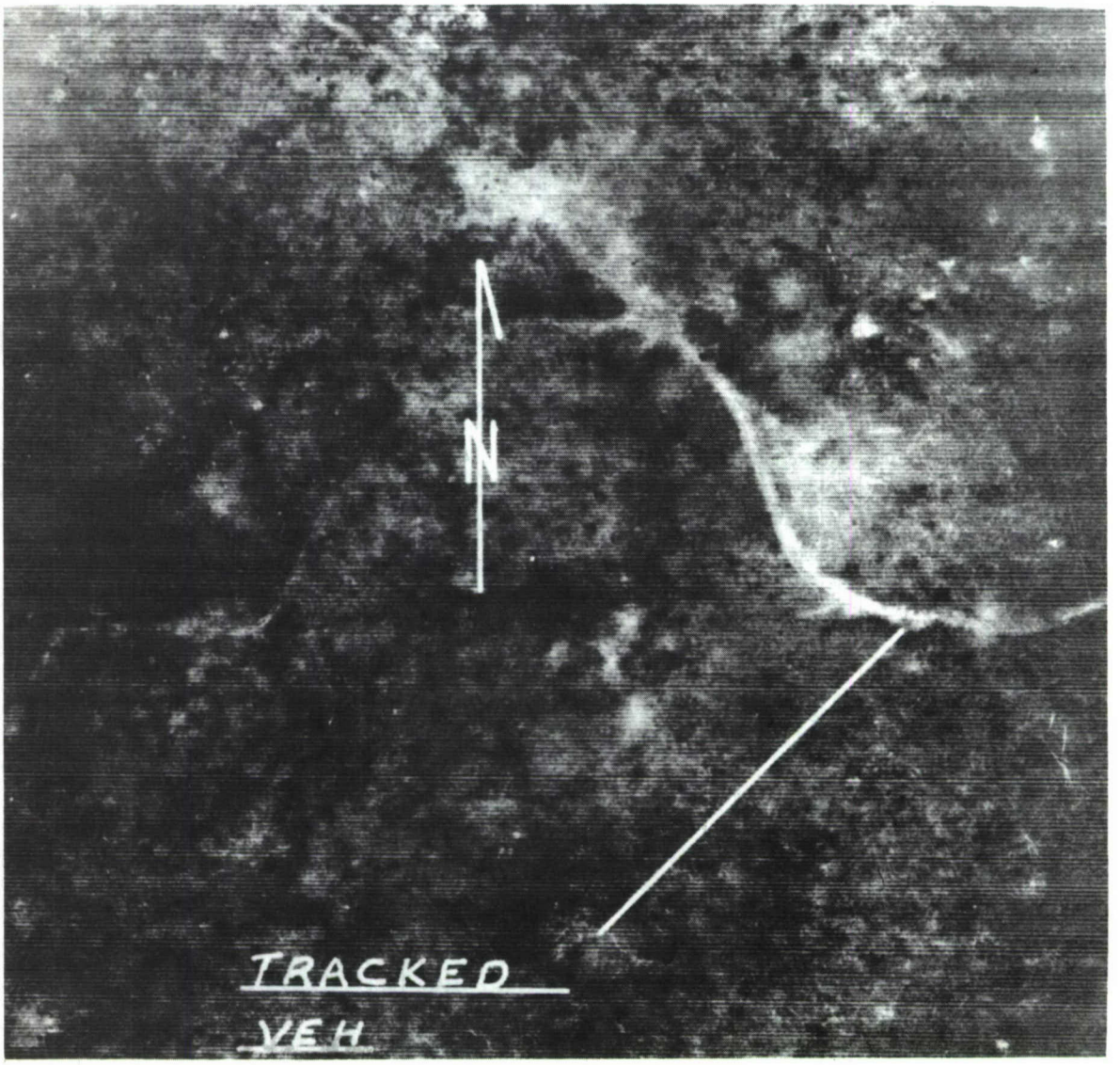
The COMPASS COUNT Laser Camera

A landmark in reconnaissance operations was reached on 2 April 1969 when a specially equipped RF-4C swooped down for a photo run over Mu Gia Pass in the first combat test of a laser camera. The laser camera came to SEA along with five specially configured aircraft under a program called COMPASS COUNT. The initial deployment of this laser system was a combat operational test program. Collection efforts, therefore, were not based exclusively on intelligence requirements.

Despite its test status, the laser camera created high expectations in the reconnaissance community. It was hoped the laser light would provide sufficient illumination for night reconnaissance and include the advantage of not producing the telltale flashes of the conventional photo cartridges which had betrayed more than one reconnaissance aircraft to enemy gunners.[45/]

Most of the operational testing of the laser system was done over the tri-border region of Laos, Cambodia, and RVN in an attempt to generate targets for the COVEY FACs. The camera itself performed with a high degree of reliability, remaining operationally ready 97.6 percent of the time. However, it was soon evident that the system was not performing as expected in the actual SEA environment. Haze and moisture significantly degraded the effectiveness of the laser illuminator. The 432 TRW tried various combinations of lenses and filters in an attempt to compensate for the haze problem, but to no avail. Moreover, as can be seen in the sample photo on the following page, the basic resolution of the laser camer was extremely poor. The laser camera departed the theater when the 11 TRS redeployed from Udorn RTAFB in November 1970.

A final evaluation of the COMPASS COUNT laser test program was forwarded to PACAF and other interested agencies early in 1970. The report concluded that the AN/AVD-2 laser simply did not meet SEA operational needs. The study concluded that an improved or modified



"COMPASS COUNT" laser reconnaissance photograph taken in May 1969 showing a tracked vehicle in northern Laos.

FIGURE 9

system with wider lateral coverage, a stabilized sensor mount, and an improved resolution capability at altitudes from 5,000 to 10,000 feet was required.[46/] If the above criteria can be achieved, the laser camera system may well prove superior to any night reconnaissance system yet developed to operate in a non-permissive air environment.

LORAN-Related Reconnaissance

A persistent attribute of reconnaissance units in SEA was their ingenuity in devising new applications for standard "in-house" equipment. Among the most significant of these innovations was the experimentation by the 432 TRW with LORAN in an effort to improve the accuracy of reconnaissance and strike operations.

Accurate target coordinates were a prerequisite for successful reconnaissance/strike operations. In SEA, however, virtually all maps, including the latest 1 : 250,000 scale Joint Operations Graphics (JOGs) contained positioning inaccuracies of up to several thousand meters. This factor, and the need for a more accurate all weather/night bombing capability, provided the stimulii for the LORAN experiments. As the only unit in SEA having both fighter and reconnaissance F-4s equipped with LORAN, the 432 TRW led the way in experimenting with the use of LORAN in targeting and coordinate reporting.

The earliest attempt at using LORAN to improve targeting was a project nicknamed "Diogenes." The basic "Diogenes" concept called for LORAN-equipped F-4s to overfly selected points as many as 20 times, and, using the "hold" feature on their LORAN navigation system, obtain

multiple coordinate readings for each of these points. By simple averaging, LORAN "coordinates" could be derived for each point. These points were plotted on aerial photographs and then used as a basis for extrapolating the LORAN coordinates for specific locations in surrounding areas. All of these coordinates were filed for possible future use as targeting aids.[47/]

"Diogenes" was short-lived, however, because its unscientific and basically inaccurate methods produced LORAN coordinates which were unsuitable for use as target coordinates.[48/]

In late 1970, two other LORAN-based target location programs were begun which promised to yield more accurate results. These were designated SENTINEL LOCK and COMBAT THUNDER.

The basic objective of SENTINEL LOCK and its successors was to obtain accurate LORAN coordinates for targets in areas suitable for LORAN-equipped strike aircraft. The heart of the SENTINEL LOCK system was a Deployable Data Base System (DDBS) constructed by the Aeronautical Charting and Information Center (ACIC) in St. Louis. To provide inputs for the DDBS, large areas of SEA were photographed by high-flying SR-71 and U-2 aircraft. The same areas were also overflown in 10 square mile segments by LORAN-equipped RF-4Cs carrying specially bore-sighted KC-9B or KS-72 cameras. Aircraft attitude parameters were annotated on each frame of photography by the RF-4s' Auxiliary Data Annotation System (ADAS).

Both sets of photography were then forwarded to ACIC, where the RF-4 photography and the data annotated in the ADAS blocks were used to compute the LORAN coordinates of the nadir point on each photo. The high-altitude photography, which covered greater areas, was then annotated with from 20 to 30 LORAN points lifted from RF-4 photos of the same area. Finally, coordinates for points in adjacent areas were extrapolated by computer and included in the DDBS. The use of computers and bore-sighted cameras to derive LORAN coordinates represented a substantial improvement in acc racy over the "Diogenes" system.

In June 1971, most of the major tactical areas in North Vietnam, Laos, Cambodia, and the Republic of Vietnam had been photographed and the film forwarded to ACIC for preparation of the DDBS. ACIC had also completed DDBSs for other areas both in BARREL ROLL and STEEL TIGER as well as the mountainous areas of South Vietnam and had forwarded them to the 12 RITS for operational use. At the time of this report, it was estimated that SENTINEL LOCK DDBSs for the other areas of operation in SEA would be available by the end of 1971.

In areas where the SENTINEL LOCK DDBS was already available, field commanders could request LORAN target coordinates simply by forwarding photography of their targets to the 12 RITS. RITS personnel then located the corresponding point on the ACIC-annotated photography and determined the LORAN coordinates of the desired targets. Once pre-strike photography was received by the 12 RITS it took approximately 45 minutes per target to derive the LORAN data.[49/]

A second experimental LORAN coordinate system was begun at the Eglin AFB Test Center in late 1970 under the code name COMBAT THUNDER. COMBAT THUNDER differed from earlier efforts in that all reconnaissance data collection and coordinate computations could be done by in-theater resources. Under the COMBAT THUNDER technique, a 432 TRW RF-4C, equipped with a bore-sighted camera and ADAS, obtained photographs of pinpoint locations and coverage of strips and even entire areas. Using the ADAS-annotated photography, a photo-interpreter could then determine the nadir points for each frame of photography and derive the LORAN coordinates for any point on the photo. The advantages of the COMBAT THUNDER method were: (1) it utilized in-theater resources; (2) it eliminated the need for maps and thus deleted map errors in coordinates; and (3) it permitted both near real-time or leisurely development of LORAN target coordinates.

The latest development in the use of LORAN to generate target coordinates was the 432 TRW's LORAN-Targeting-By-Grid-Annotated Photography (LT GAP) program. LT GAP was essentially a derivative of the COMBAT THUNDER technique, but differed from it by the use of grid-annotated aerial photography. The basic purpose of the LT GAP system remained the same: to provide a method of deriving LORAN coordinates without recourse to maps.

The basic LT GAP field "kit" consisted of a set of annotated photographs for a given area together with a map-index of the photography. In operation, a LT GAP user (usually a FAC or other airborne observer)

LT GAP Photo of the Tan Son Nhut Area

FIGURE 10

would locate a target, select the photo or photos of his target area from the LT GAP kit, and then determine the target's LT GAP coordinates. It should be kept in mind that the LT GAP grid was an arbitrary one in which the grid lines did not correspond to any specific ground distance or measurement. The FAC would then radio the LT GAP coordinates to the 432 TRW where photo interpreters, using identical photographs would compute the target's LORAN coordinates by means of standard COMBAT THUNDER formulas. The target's LORAN coordinates were then passed to the BLUE CHIP command post or other command element for relay to strike forces.

The first field test of the LT GAP concept was during Operation Lam Son 719. An area approximately 28 by 44 nautical miles containing significant enemy activity was selected, flight lines were drawn and photo coverage was obtained using the KS-72 csmera. The KS-72 photos were then enlarged to a size of approximately 10 x 10 inches printed with a LT GAP grid overlay, indexed by map area, and packaged into kits for distribution to FACs and other field users. On 11 March, a team composed of 7AF and 432 TRW personnel went to Quang Tri to brief Direct Air Support Center (DASC) V and 23 TASS personnel on the LT GAP system. 50/

The Lam Son test of the LT GAP system was a failure. More urgent requirements, such as immediate support of troops in contact, Arc Light strikes, and other priority missions preempted FAC testing of the LT GAP kits. The briefing team from 7AF found DASC V to be a "beehive of activity" and its personnel "too busy to give more than cursory attention"

to the LT GAP concept.[51] Among other problems were FAC complaints that the LT GAP kits were bulky and difficult to use in the close confines of the cockpit. Photos of key areas along Route 9 were mutilated and lost and the original scale of the index map in each kit (a JOG) was found to be too large for easy use. Interviews with personnel involved in the Lam Son 719 test program also indicated that field commanders did not completely understand that LT GAP would work properly only if the use of charts was avoided. On more than one occasion it was suspected, although never proven, that field users were obtaining target coordinates, and then radioing for air strikes. This reintroduced the very chart coordinate errors which LT GAP sought to avoid.[52]

A more meaningful evaluation of the LT GAP technique was made on 27 March in the BARREL ROLL area of Laos. With the approval of 7AF, the 432 TRW ran a one day full scale test of the entire LT GAP concept. RAVEN FACs were provided with LT GAP kits and called in targets using the LT GAP coordinate system. The 432 TRW responded by generating two-ship sorties of F-4Ds at 20-minute intervals throughout the day. Approximately 400,000 pounds of munitions were expended during the day by the LORAN equipped aircraft. Post-strike photography, while not covering all of the bombed areas, indicated that CEPs of 150 to 200 meters had been achieved.[53]

By July 1971, the LT GAP program was gaining wider acceptance and use. The 432 TRW expanded the areas covered by LT GAP photography with the emphasis on coverage of sensitive areas in Laos and selected air bases in South Vietnam as a contingency base defense system.

The RF-4C/KA-82 Modification

The 460 TRW's mating of the KA-82 medium altitude panoramic camera with the RF-4C was an example of a highly successful and useful field modification of "in-house" equipment. This new combination yielded the best tactical photo reconnaissance yet seen in SEA. It also generated considerable controversy and paper work as 7AF and the 460 TRW sought to gain formal approval for their unorthodox modification.

As early as 1967 the need for an improved medium altitude camera system had been recognized and incorporated into a SEA Operational Requirement (SEAOR). The need to fly higher and faster due to the increasing ground fire threat rendered existing RF-4C cameras partially or wholly inadequate, while reasons such as cost and over-sophistication had prevented the development of new camera systems. In July 1970, the requirement for a new camera was restated in Tactical Air Command Required Operational Capability (TACROC) 19-70, but again no camera appeared. By December, the medium altitude camera for the RF-4C had become a priority sensor improvement item on the equipment modernization list of TAC.[54/]

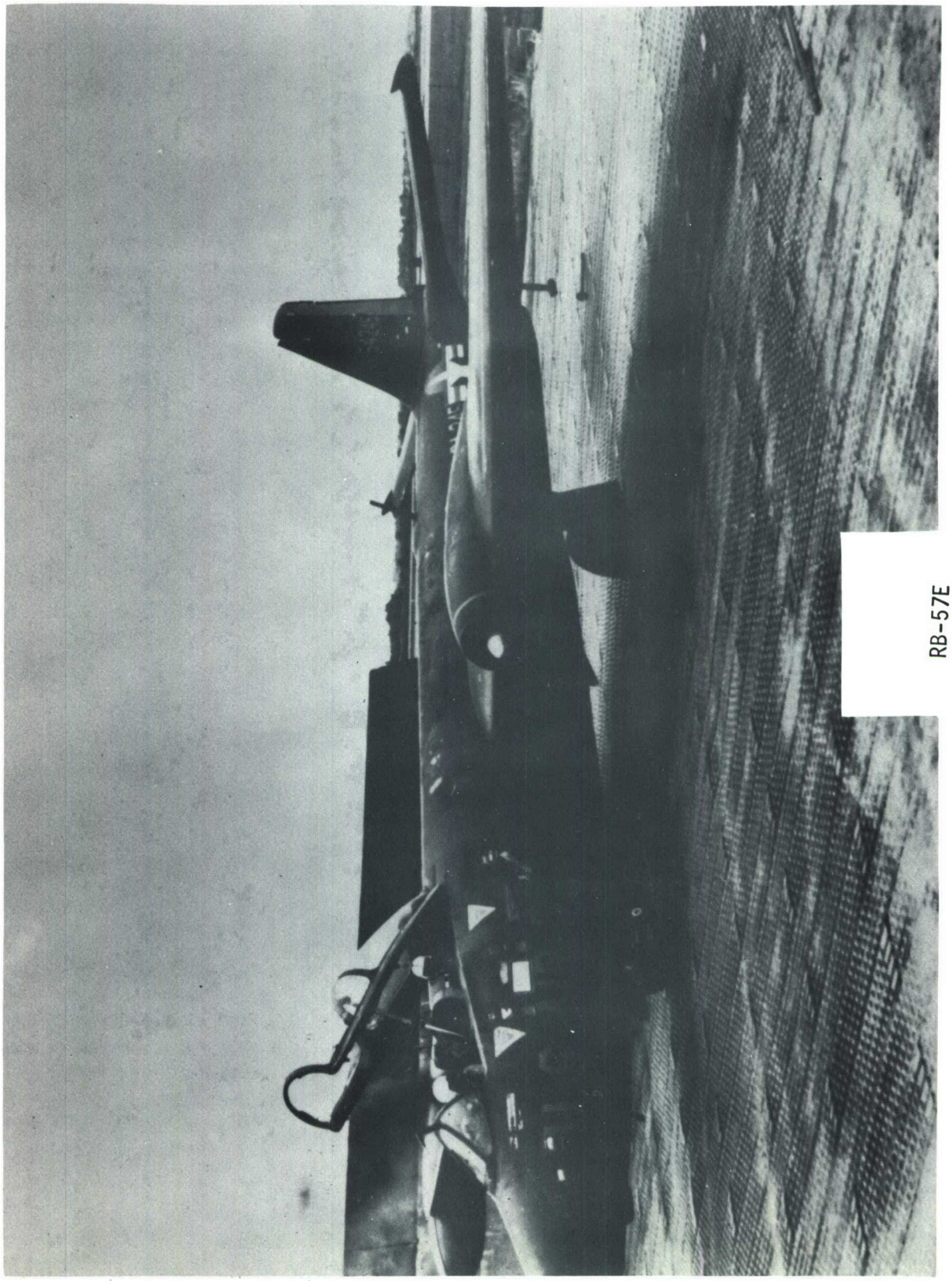
As an interim solution to the pressing need for new medium altitude equipment, reconnaissance managers turned to the KA-82 high resolution camera which was already present in SEA. The KA-82 was a BIG SAFARI* special procurement item which had been purchased in the mid-1960s at a cost of approximately $200,000 per unit. It had been deployed to SEA

*An AFLC logistics support system for specialized projects.

in four RB-57Es assigned to Detachment 1, 460 TRW at Tan Son Nhut Air Field. By 1969, the RB-57/KA-82 combination had proven itself repeatedly and allowed photo interpreters to achieve maximum intelligence exploitation from each sortie flown. During the COMMANDO HUNT dry season interdiction campaigns the KA-82 had been especially valuable in detecting enemy supplies being infiltrated through Laos into Cambodia and South Vietnam and had proven itself ideal for surveillance of enemy lines of communication (LOCs), base egress and defensive positions. The high acuity imagery produced by the KA-82 permitted photo interpreters to identify enemy equipment (trucks, AAA weapons, etc.) which other cameras could not detect because of shadows and jungle canopy. 55/

The major drawback to the RB-57/KA-82 combinations was the aircraft's relative vulnerability to enemy ground fire. By mid-1970, the RB-57 had been withdrawn from operations in high-threat areas and was reassigned to more permissive areas in Cambodia and South Vietnam. The reorientation of the RB-57 missions together with the redeployment of the RF-101s and their KA-1 cameras from SEA made the need for a new medium altitude sensor increasingly acute.

To meet this requirement, maintenance personnel of the 460 TRW in August 1970 removed a KA-82 from a RB-57 and installed it by means of a special mount in the high altitude station of one of the Wing's RF-4Cs. Since there were sufficient KA-82s available to meet the RB-57's needs, the Wing initiated a three-month test program to evaluate the



RB-57E

FIGURE 11

feasibility of using the KA-82 in the RF-4C on a regular operational basis. The initial results were so encouraging that an additional RF-4C was outfitted with a KA-82.

In December 1970, the RF-4C/KA-82 combination was nearly terminated when PACAF ordered the removal of the KA-82 from the RF-4 on grounds that the modification was an unauthorized and ill-advised diversion of BIG SAFARI assets. Seventh Air Force and the 460 TRW immediately appealed for reversal of the PACAF directive and asserted that the KA-82 imagery was far superior to that produced by any other sensor in the SEA tactical reconnaissance force. The 460 TRW noted that since KA-82 equipped RF-4Cs could cover more areas per sortie than conventionally equipped RF-4s, previous reconnaissance force reductions were partially offset. In addition, the RF-4C/KA-82 combination permitted high-resolution operations in areas denied to older and slower reconnaissance aircraft such as the RB-57. The KA-82's large area coverage combined with the high speed characteristics of the RF-4C eliminated or reduced the need for multiple passes over heavily defended areas, thus reducing the risk to aircrews operating in such environments.[56/]

Seventh Air Force and the 460 TRW efforts were successful and PACAF withdrew its opposition to the modification and operational use of the RF-4C/KA-82 combination. During COMMANDO HUNT V KA-82-equipped RF-4Cs performed the critical search for enemy sites in Laos and North Vietnam and significantly contributed to meeting this threat.

As with all such systems, the RF-4C/KA-82 combination was not without problems. A major consideration was the need for special handling of the exposed KA-82 film. Under the TAC RISE organization, each PPIF was equipped with Versamat film processors. However, no commercial chemistry was known to be available that could be used in the Versamats to provide the combination of adequate processing speed and the desired level of resolution for the KA-82 high definition film.* Since the Houston Fearless HTA-3s at the 12 RITS had acceptable chemistry, all KA-82 film returned by 460 TRW aircraft was sent to the RITS for developing and then returned to the 12 PPIF for exploitation. The need for HTA processors, which were not standard TAC RISE PPIF equipment, raised questions about the KA-82's compatability with the overall TAC RISE system. A second drawback was that normal aerial color film was too thick to be threaded through the KA-82's film advancement mechanism. In April 1971, however, the 460 TRW modified the camera so that it would accept a special thin-base Eastman Kodak color film. Although this film gave photo interpreters a better tool by which to penetrate jungle-cover and detect camouflaged enemy positions, it created special difficulties. This Kodak film was not a standard stock item and had to be purchased at the relatively high cost of $518 per 1,600 foot roll. Another drawback was the long processing time (nearly eight hours for a 1,600 foot roll) which appreciably lengthened the exploitation cycle. As a result of these limitations, the KA-82's color capability was used only on very

*Subsequent to the period covered by this report, a non-stock listed chemistry which produced good speed and resolution was procured. This enabled the 432 TRW to process KA-82 film in versamats.

high priority missions, such as during the Lam Son 719 operation of February-March 1971.[57/] Despite its cost and special support requirements, the KA-82 sensor was the only high-acuity, medium altitude camera available to the SEA reconnaissance force and the RF-4C/KA-82 combination remained a mainstay of the SEA photo reconnaissance force.

Electronic Reconnaissance Operations

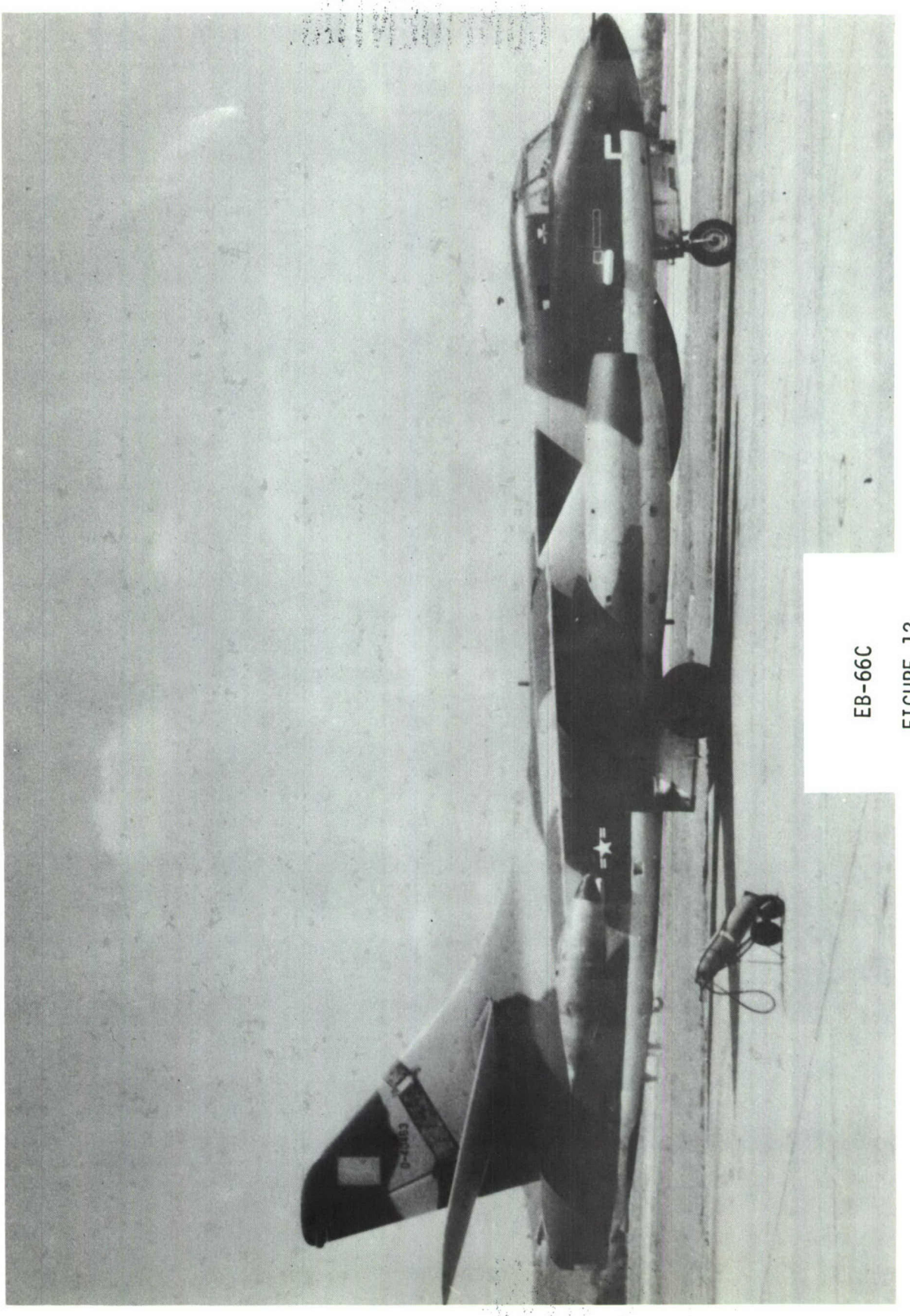
During the period of this report, USAF tactical electronic warfare support forces in SEA were cut nearly in half, with the result that the remaining force frequently encountered difficulties in meeting all requests for support. In January 1970, the 7AF Electronic Warfare Support Measures (ESM) force consisted of 18 EB-66s assigned to the 42 TEWS at Takhli RTAFB.[58/] This represented a sharp decline from the 1968 high of 35 aircraft in two squadrons at Takhli RTAFB.[59/] In September, the BANNER SUN force reductions in Thailand cut the force even further, leaving the 42 TEWS with eight EB-66Es and five EB-66Cs. At approximately the same time the 42 TEWS relocated from Takhli to Korat RTAFB when the former base closed down.

A survey of the electronic reconnaissance effort required to support the COMMANDO HUNT V dry season interdiction campaign illustrates how thin the EB-66 force was spread by the end of 1970. During this COMMANDO HUNT effort, which ran from October 1970 through April 1971, daily 24-hour electronic reconnaissance coverage of the interdiction areas and Route Pack 1 was considered vital because of the threat posed by enemy SAMs and radar-controlled AAA. Poor weather during the first weeks of the

campaign limited effective photo reconnaissance, thus making the electronic reconnaissance vitally important to fix the location of the enemy's missiles and guns. To compound the problem, the enemy practiced excellent transmission security, keeping his radars turned off until he was ready to fire. The broadest possible coverage was required to enhance the probability of intercepting enemy radar emissions during times when he was performing quick maintenance and calibration tests of his equipment.

The five EB-66Cs of the 42 TEWS constituted the primary ESM force available to 7AF for COMMANDO HUNT V. These aircraft provided the capability for three sorties or approximately eight hours of coverage each day.[60/] When a request for the release of national ELINT resources was turned down because of a worldwide shortage of ELINT collection platforms, 7AF turned to outside resources to obtain the necessary coverage.[61/] A coordinated schedule was developed with the U.S. Navy's Carrier Task Force (CTF) 77 by which EA-3B, EC-121 and EP-3B collection platforms began covering periods between EB-66 missions. During Lam Son 719, more fleet resources were added as EA-6As from the 1st Marine Air Wing were used to intensify the coverage of high threat areas. Additional support was also provided by SAC's COMBAT APPLE EC-135s, which covered RP 1 for 12 hours on two consecutive days each week.

The data collected by the electronic reconnaissance task force was returned to the aircraft's home base with the aircraft, where it was processed and forwarded to 7AF via the OPREP-4 reporting system.



EB-66C

FIGURE 12

Simultaneously, the data was sent to the Pacific Command ELINT Center (PEC) at Hawaii for more sophisticated analysis. The PEC, in turn, produced publications on enemy Electronic Order of Battle (EOB) and other subjects of use to tactical commanders in mission planning and threat assessment. Inevitably, however, analysis and preparation of electronic intelligence took time; in some cases up to 24 hours passed before mission data reached field requestors.

The interface of USAF, Navy, and Marine resources gave COMMANDO HUNT V the 24-hour ELINT support it required. But the experience underscored the critical nature of the USAF's diminished ELINT force. In addition to aircraft shortages, the COMMANDO HUNT V experience demonstrated that the Air Force badly needed a new tactical electronic warfare support platform while the time delays in data processing pointed up the need for a near-real time inflight relay capability. Even more serious was the fact that the EB-66 was itself antiquated and that many of its sensors reflected the "state of the art" of the late 1940s. A critical shortcoming was the inability of the EB-66's Direction Finding (DF) equipment to accurately locate enemy radar sites. At best, the DF and navigation equipment of the EB-66 was capable of placing a radar within a circle having a radius of approximately 10 nautical miles. The inherent inaccuracy of the equipment was compounded by the enemy's transmission discipline; short transmission bursts by the enemy's radar frequently permitted only a single-line bearing on the transmitter locations.[62/]

At the time of this report, the EB-66 force had narrowly escaped still another force cut. A proposed deletion of the EB-66 from the 7AF inventory by July was averted by a last minute Air Staff decision to extend the 42 TEWS at a 13 UE level through the third quarter of FY 73.[63] Attempts by 7AF to obtain an upward revision of the EB-66 for to a 20-plane force (13 EB-66Es for ECM and 7 EB-66Cs for ESM) were unsuccessful. Consequently, the aging EB-66 continued as the backbone of the USAF's ESM force in SEA.

ARDF Operations

Tactical Airborne Radio Direction Finding continued to play an important role in the overall reconnaissance effort in SEA. Statistics on the effectiveness of ARDF varied with the source, but all agencies agreed that the demand for ARDF intelligence far exceeded the available resources.[64] ARDF fixes were used to maintain current order-of-battle information on large numbers of enemy units in SEA; many of those located in Cambodia and Laos were identified solely on the basis of ARDF-supplied intelligence.[65]

Secure communications between ARDF aircraft and the Direct Support Units (DSUs) permitted rapid reaction to ARDF location of enemy positions. The reactions varied but included artillery fire, insertion of ground forces, air strikes, scheduling of FAC and photo reconnaissance missions, and occasionally ARC LIGHT (B-52) targeting.

The seemingly ageless EC-47 "Gooneybird" continued to be the workhorse of the Air Force's ARDF fleet in SEA. In June 1971, there were 58 EC-47s engaged in ARDF operations. These were concentrated in three squadrons assigned to the 460 TRW. The aircraft were located at four bases to provide maximum geographic coverage.*

During the period covered by this report, two significant events occurred within the Air Force's ARDF program. These were (1) implementation of a program to "Vietnamize" ARDF assets in SEA, which will be discussed in detail in a later chapter, and (2) attempts to utilize ARDF fixes in conjunction with other reconnaissance sensors in a near real-time mode.

The first effort to use ARDF fixes in conjunction with other sensors was Project CONTRAIL which began on 11 August 1970. The CONTRAIL concept called for EC-47 ARDF fixes to be passed to an orbiting RF-101, which would immediately photograph the suspected area. A total of 24 CONTRAIL photo sorties were flown between 11 August and 7 September with 80 targets being photographed. Numerous attempts were made to photograph such important targets as Central Office for South Vietnam (COSVN) Headquarters and the COSVN tactical control center.

*The 360 TEWS stationed at Tan Son Nhut, flew missions in Military Regions 3 and 4 and in Cambodia. Detachment 1 of the 360 TEWS was stationed at Nakhon Phanom RTAFB and flew in the BARREL ROLL area. The 361 TEWS was at Phu Cat and covered MR 2 as well as areas in MR 1 and STEEL TIGER. The 362 TEWS flying out of Da Nang, covered MR 1 and part of the STEEL TIGER area.

Readout of the CONTRAIL photography by the 460 TRW indicated that some of the areas covered might be lucrative for strike targeting based on the presence of trail activity and structures in the area. However, detailed analysis of the photography failed to contribute additional data beyond that normally obtained from analysis of ARDF missions. In September, the disappointing results yielded by CONTRAIL photography led 7AF DCS/Operations to propose that the project be cancelled.[66/]

Early in 1971 a second attempt was made to coordinate ARDF fixes with other reconnaissance operations. On 1 February an EC-47 RAVEN FAC Targeting Test Program was initiated in the Bolovens Plateau area of Laos. Early missions in the program were hampered by poor communications between the EC-47s and the Airborne Battlefield Command and Control Center and the lack of encoding devices to allow targeting information to be passed to RAVEN FACs over secure radio circuits.

Despite these initial difficulties, the program achieved some success. On 3, 4, and 5 February, for example, five ARDF fixes were passed to the RAVEN FACs by ABCCC. Three of the fixes were investigated by the FACs who directed USAF F-100 and Laotian T-28 air strikes against the locations. The strike results were reported as 25 camouflaged buildings destroyed and several secondary explosions.[67/]

On 27 February, the Targeting Test Program was interrupted when the main ARDF effort was redirected to support Operation Lam Son 719. Attempts were made to reinstate the test program by using HAMMER and

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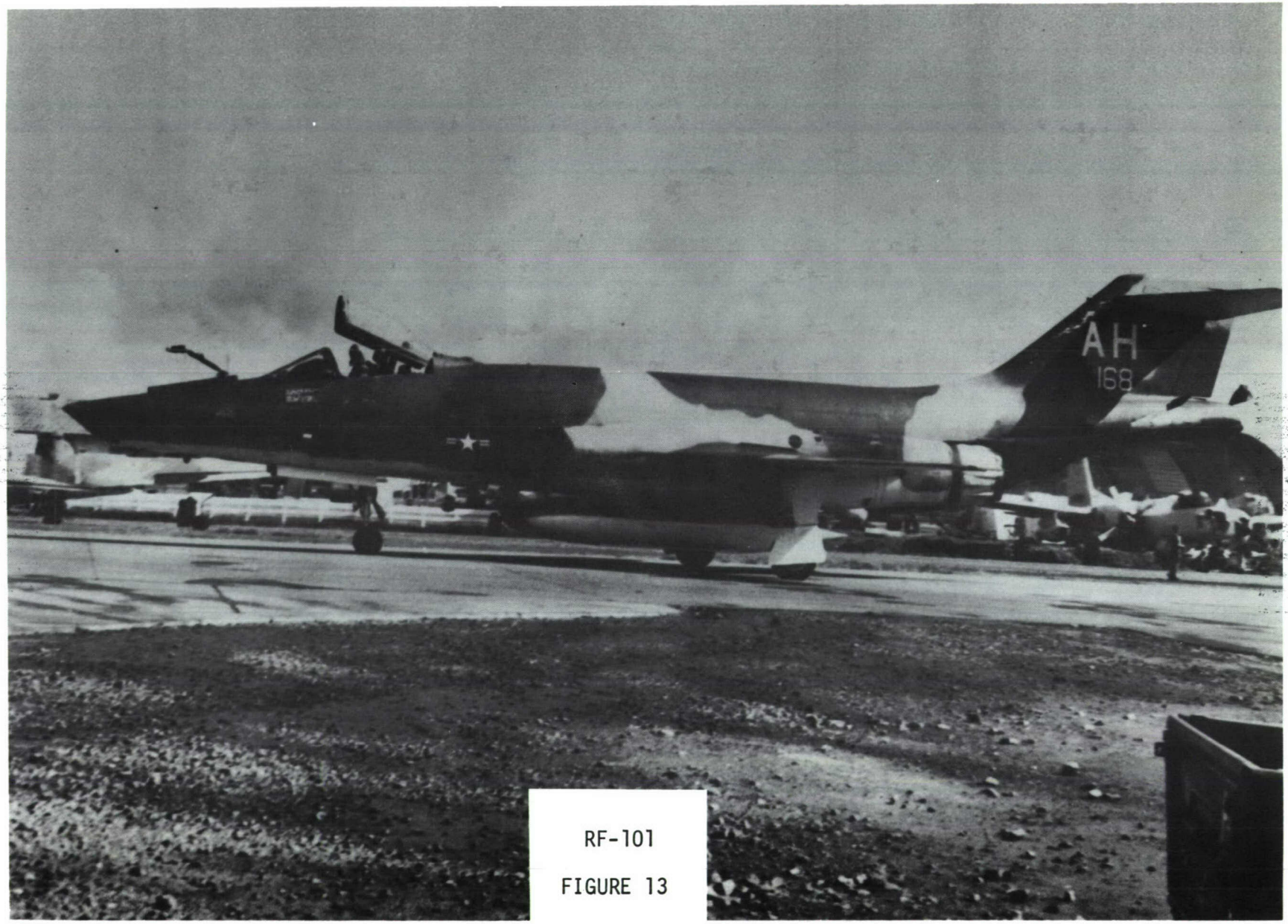


RF-101

FIGURE 13

UNCLASSIFIED

NAIL FACs to conduct visual reconnaissance of ARDF-derived enemy locations. The EC-47s made available near real-time ARDF fixes, but numerous TICs and the large number of air strikes required by ARVN forces engaged in the Lam Son 719 operation severely limited the availability of FAC support for the Targeting Test Program.[68/]

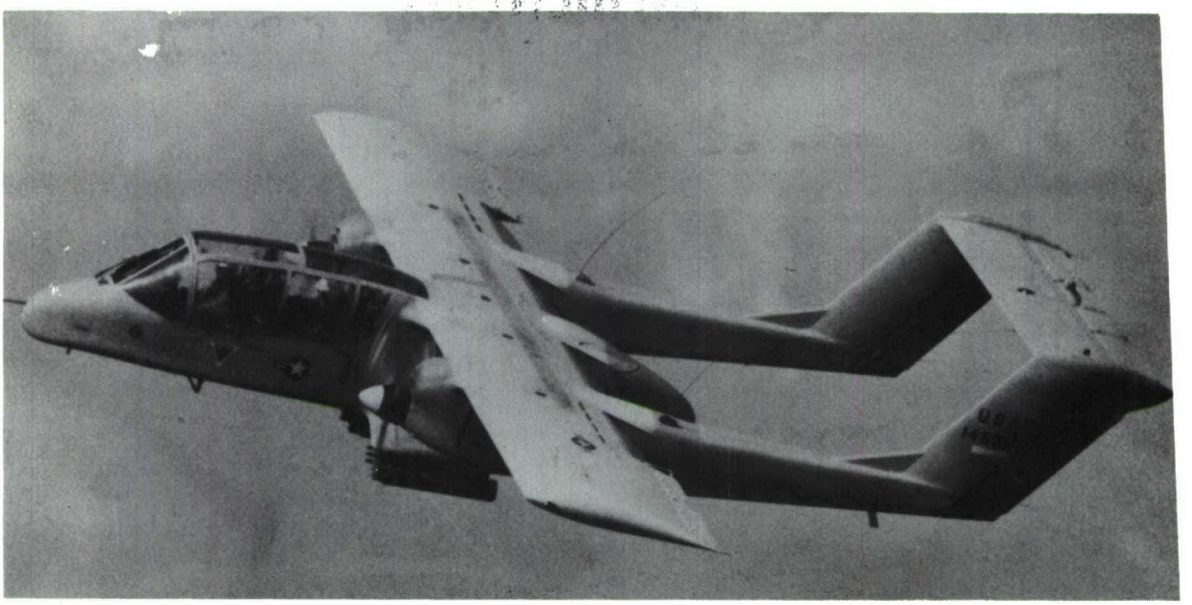
In May, the EC-47/FAC test resumed in Cambodia under the code name BLUE BEETLE. A 7AF message outlined the program and indicated why Cambodia was considered to be an ideal area for further testing of the ARDF/FAC liaison concept stating:[69/]

> *The enemy is known to use low-powered HF to conduct his activities in Cambodia. He may locate his transmitter as much as one or two kilometers from his actual position to prevent discovery. Direct targeting of an airborne radio direction finding (ARDF) fix may thus prove fruitless. Experience learned during trials with RAVEN FACs. . . in Laos indicated that lucrative targets can be discovered by having a FAC VR the fix areas as soon as possible after fixing is completed.*
>
> *. . .Current enemy operations in Cambodia, coupled with more FAC VR time, less heavily camouflaged jungle areas, and no AAA threats present a desirable situation for further exploration of the EC-47/FAC targeting concept. Basic prerequisites for the exploration of the concept are a thorough understanding by the FAC of what the ARDF fix can provide him, detailed feedback by the FAC of results he obtained in its use, and a complete understanding of the stringent security measures that must be adhered to by all participants.*

BLUE BEETLE usually involved an average of five EC-47 missions daily. Only fixes with an accuracy of 1,000 meters or less were passed via secure voice communications to the participating TILLY, SUNDOG, and RUSTIC FACs which flew over Cambodia. Observed results of ARDF-generated strikes were passed directly from FAC units to 7AF and the 6994 Security Squadron via Daily Intelligence Summary (DISUM) reports.[70/]

In the first 10 days of BLUE BEETLE operations, 216 ARDF fixes were passed to the FACs who investigated 65 of them. Eight VR sightings were subsequently struck by air and strikes were requested on four others but were not struck for various operational reasons. During this 10-day period, an enemy radio complex with 11 antennas was located, air strikes were directed against an estimated 700 enemy discovered hiding in a tree-line, and two enemy columns and a command post complex were sighted.[71/]

The Cambodian BLUE BEETLE operations reemphasized the problem of mission priorities which had arisen earlier in the EC-47/FAC test program. During operations in May, a significant number of fixes passed to the FACs could not be acted upon because FAC aircraft were engaged in higher priority missions. On 25 June, the problem was resolved when the 7AF Commander gave the EC-47/FAC program the highest mission priority. To further enhance the effectiveness of the program, 7AF began assigning a FAC and four F-4s to work directly with a primary and alternate EC-47 in order to provide timely reactions to fixes obtained by these two aircraft.[72/]



C-47

FIGURE 14

A second question regarding EC-47/FAC collaboration involved the rules of engagement (ROE). USAF Security Service personnel, while highly pleased with BLUE BEETLE results, felt that a revision of the ROE would made the EC-47 program even more effective. Under the existing ROE, no air strike could be called in on an ARDF fix unless the FAC could visually acquire a target. This led to the passing up of fixes which the intelligence analysts felt would be highly lucrative. In one case, ARDF/SIGINT fixes placed an enemy transmitter in the same location for 21 straight days. FACs responding to the fixes were unable to locate visually a strikeable target and no action was taken.[73/]

Although the ROE question remained unresolved, the effectiveness of the BLUE BEETLE program had been proven by June 1971. It had been demonstrated conclusively that tac air could exploit ARDF fixes on a near real time basis. In early July, plans were being finalized to expand the EC-47/FAC program into other areas of SEA and consideration was being given to the inclusion of gunships in the ARDF/FAC/strike team.[74/]

CHAPTER III

DRONE RECONNAISSANCE

Background

Reconnaissance drones have played an important role in Southeast Asia operations for several years. The first reconnaissance drone missions in SEA, nicknamed BUMBLE BUG, began in the fall of 1964 when high-altitude drones were sent over North Vietnam.[75] Specially modified versions of these drones were also used in 1965 and 1966 for electronic intelligence collection. ELINT drone missions were flown to locate and determine the emission characteristics of FANSONG fire control radars and to obtain arming and fusing data on the associated SA-2 "Guideline" missile.[76] Although useful in the ELINT role, the drones proved more valuable as collectors of photographic intelligence.* Camera carrying drones, or "Bugs" as they were called, brought back excellent quality imagery of critical targets including SAM sites and antiaircraft positions in North Vietnam.**[77] The drones also proved useful during the northern monsoon season when low ceilings made flying over the heavily defended northern areas prohibitive for manned aircraft.[78]

* The U.S. Navy also had a drone program, code named BELFRY EXPRESS, that operated for a short period in late 1969 and early 1970. Operational control was vested in TF-77 which launched and recovered all missions.

** The drone "take" occasionally turned up surprises, such as on 3 December 1969 when a "bug" returned imagery showing another Ryan reconnaissance drone sitting on Phuc Yen Airfield in North Vietnam.

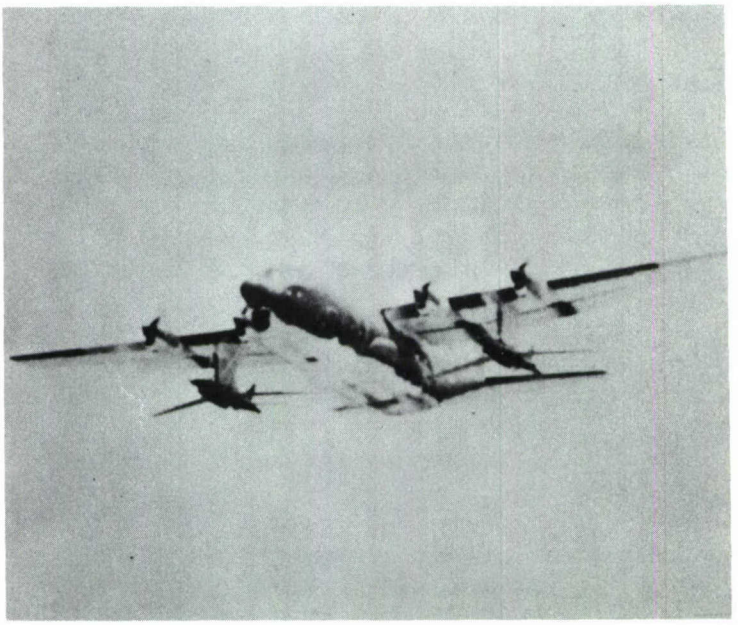
The Vehicle

The reconnaissance drones which were sent over North Vietnam were direct descendants of the Ryan Aeronautical Company's "Firebee" target drone which made its first powered flights at the Holloman Air Development Center in 1951. The first photo reconnaissance drones were essentially modified versions of the "Firebee" with extra fuel capacity and new guidance systems.[79] Several variants of the "Firebee" were still flying in 1971 including the Ryan Model 147S low altitude drone and the Model 147T high altitude drone.[80]

The high altitude drone had a wingspan of 32 feet, as compared to the 12 feet for the low altitude version. Most drones were powered by a Continental J-69 turbojet weighing less than 360 pounds but developing approximately 1,920 pounds of thrust. The newer drones of the "T" series were powered by a J-100 engine developing 2,700 pounds of thrust. All versions had a self-contained guidance system consisting of a programmer compass, doppler equipment, and autopilot. The self-contained guidance system permitted internal control of the drone through all phases of its mission.[81]

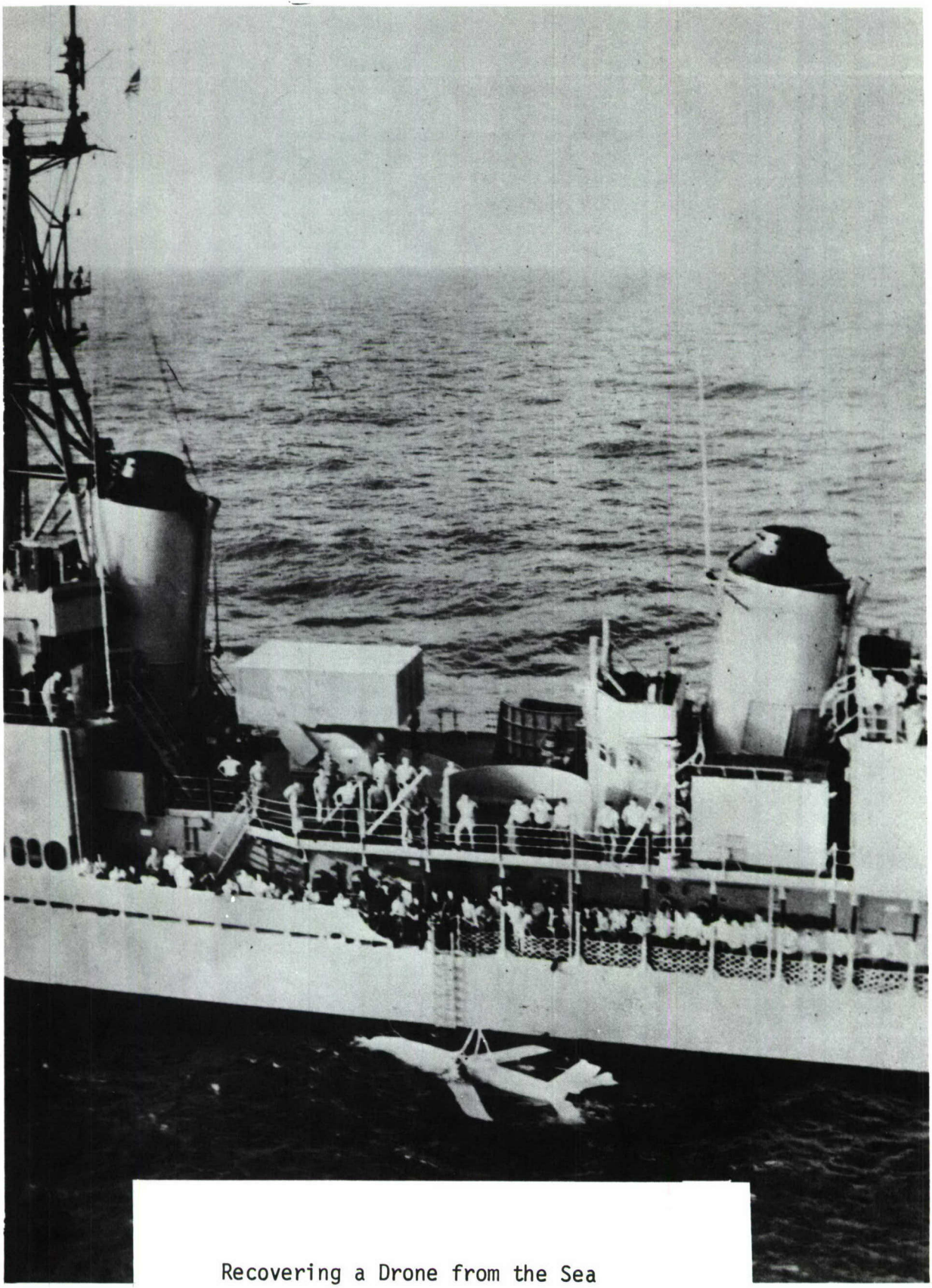
Several camera systems were used in the photo-drone operations. The standard low-altitude camera was the Fairchild F-415Y,* a three-inch focal length, 180 degree panoramic-scan camera, with a 9.4 x 2.25

* The F-415Y, a modification of the KA-60, was designed specifically for use in the Buffalo Hunter drone.



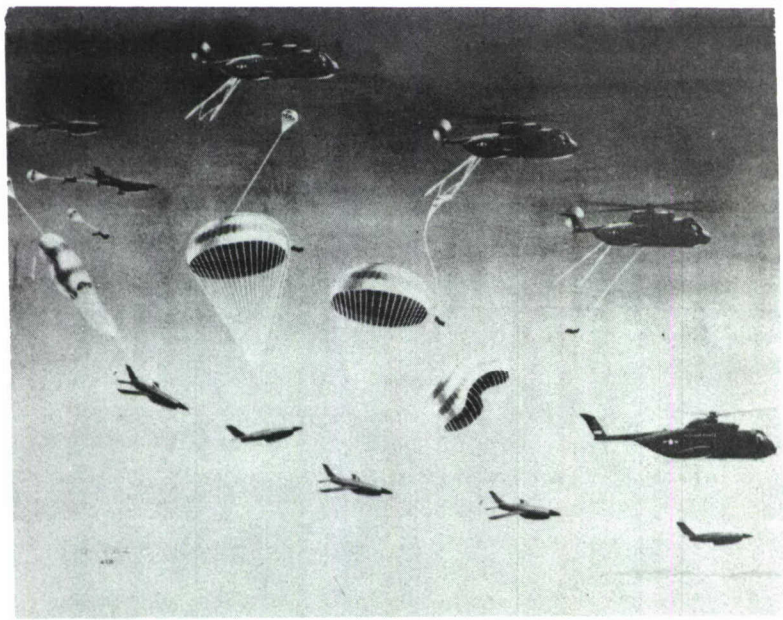
Two high-altitude drones are carried by this DC-130A launch platform

FIGURE 16



Recovering a Drone from the Sea

FIGURE 17



Artist's conception shows CH-3 Mid-Air Recovery System sequence in drone recovery

FIGURE 18

As of mid-1971, the launch rate for photo-reconnaissance drones was approximately 25 missions per month. Low altitude missions over North Vietnam began in March 1966 and subsequently became the standard mission profile. Operational experience taught that the drone's survivability was improved by flying as low and as fast as possible. Thus low profile missions increased from 58 percent in 1967 to 95 percent in 1970.[89/]

Another advantage of low profile BUFFALO HUNTER missions was that cloud cover was less of a hindrance than with high altitude drones, especially during the northeast monsoon season. (Poor weather also reduced the effectiveness of low altitude drone missions, although not to the extent that it affected manned systems.) Low profile drone flights yielded generally better target imagery resolution than high altitude missions, although this was realized at the expense of broader area coverage.[90/]

Overall, the "Bug" proved to be a difficult target for enemy air defenses. Its relatively small radar cross section made it an elusive target to acquire electronically. Of the 291 drones launched for overflight of the North in 1970, only three percent were known to have been lost to enemy action. SAMs knocked down five of the drones, MIGs shot down three and antiaircraft fire accounted for one. Another six percent were lost due to operational causes. Thus, of all the drones launched in 1970, approximately eight of every nine were successfully recovered. EB-66s of the 42 TEWS and EA-6As from the 1st Marine Air Wing played an

ECM

important role in obtaining this high survivability rate by degrading enemy radars with electronic counter-measures.[91/]

Technical Support for Drones

Once a drone returned to Da Nang the exposed film was downloaded and prepared for shipment within two hours via T-39 SCATBACK courier to the processing facility at the 12 RITS.[92/] After its arrival at 12 RITS, the film was developed on a priority basis within five hours and sent directly to the "Bug" exploitation team, composed of the most experienced photo interpreters in the facility. The "Bug" team performed first-phase Initial Photographic Interpretation Report (IPIR) readout and turned the film over to another team for second phase (SUPIR) readout. The 12 RITS printed copies of the photography for delivery to in-theater and national agencies.[93/]

CHAPTER IV

THE VIETNAMIZATION OF RECONNAISSANCE

Background

The reconnaissance resources of the Vietnamese Air Force have traditionally been weak primarily because of the VNAF's lack of equipment and emphasis on this mission and its reliance on USAF reconnaissance.[94/] The introduction of six RF-5As into the VNAF inventory during the latter part of 1970, however, heralded a change from previous patterns. At the same time, plans to further enlarge its reconnaissance resources by providing additional RC-47 photo reconnaissance and EC-47 ARDF aircraft were being finalized. The VNAF still lacked the capability to take over the in-country reconnaissance function, but it was clearly headed towards that goal.

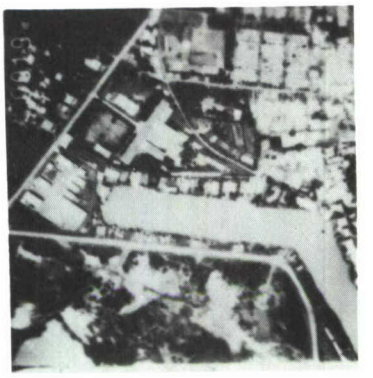
Seventh Air Force planners began giving detailed consideration to the future shape of the VNAF reconnaissance force during 1969 at a time when the VNAF had only a limited reconnaissance function and capability. Of the total photo reconnaissance resourses of the Free World Forces in Vietnam at the end of 1969, only four percent were owned by the VNAF.[95/] These meager resources were concentrated in the VNAF's 716 Reconnaissance Squadron at Tan Son Nhut Airfield, which possessed nine U-6As, one EC-47 (used for flight checks of navigation facilities at air bases around the Republic) and three RC-47s.[96/]

Photo Reconnaissance

Although the VNAF performed some ARDF missions with its U-6As, its primary effort was photographic reconnaissance. Three RC-47s fitted with glass panels in the bottom of the fuselage and K-17 and K-38 cameras were capable of producing large format, large scale photography suitable for intelligence exploitation purposes.[97] However, most of their effort was directed towards obtaining photography for strips, mosaics and photo-maps.* RC-47 missions were never the result of immediate requests by ARVN field commanders for real-time photo intelligence. Instead, they flew photo reconnaissance in response to preplanned requirements of the Joint General Staff and, occasionally, 7th Air Force and MACV.[98]

The primary mission for the glass-bottomed RC-47s was to perform daily coastal surveillance. The VNAF's 716 Reconnaissance Squadron furnished the flight crews while Vietnamese Navy personnel performed the actual visual reconnaissance. The combination proved to be a happy one. The RC-47s flew at an altitude of 700 feet, allowing the Navy observers to inspect watercraft at close quarters. As one American advisor commented, "if there is one boat out of place they (the Vietnamese Naval observers) can spot it immediately."[99] Radio contact between the RC-47s and Naval vessels permitted rapid reaction to inspect and, if necessary, board suspect craft.[100]

* Although limited resolution hampered detailed photo interpretation, the RC-47's cameras were ideal for area coverage, plotting, and mosaic construction.



Comparison of K-17 and KS-92A Photography

FIGURE 19

Despite its successes with visual coastal surveillance, the VNAF's overall reconnaissance capability remained extremely limited. Even with the planned Phase II force increase of six RF-5As, the VNAF would still be in a position to perform only 10 percent of the total photo reconnaissance effort.[101/] To remedy this deficiency 7AF Improvement and Modernization (I&M) planners recommended that an additional nine RC-47s be added to the VNAF's inventory under the Phase III program. Such action would insure that all of the Republic's military regions would receive adequate photo coverage once the USAF's RF-101s and RB-57s were withdrawn. Tentative planning called for the VNAF to disperse three RC-47s to each of four locations, Da Nang, Pleiku, Tan Son Nhut and Binh Thuy, in order to provide the desired coverage.[102/] The VNAF's reconnaissance force structure was to be as follows:

Aircraft	VNAF Strength in June 1970	VNAF Strength in December 1971	VNAF Strength by FY 1974
U-6A	8	8	8
EC-47	1	1	21
RC-47	3	3	12
RF-5A	0	6	6
*Squadrons	1	1	2

* The 718 Reconnaissance Squadron, with a UE of 20 EC-47s, was scheduled for activation in the second quarter of FY 73. It would be responsible for all ARDF missions, while the 716 RS was to continue in its photo reconnaissance role.

By June 1971, the VNAF's photo reconnaissance resources were beginning to expand. The six RF-5A aircraft programmed under Phase II had arrived from the U.S. by late 1970 and were assigned to the 522 Fighter Squadron at Bien Hoa (which flew the F-5) for ease of maintenance. Pilot transition training was completed and operational reconnaissance sorties in support of the Joint General Staff were being flown by the end of the year. In June, the VNAF also began flying photo reconnaissance sorties in support of 7AF and MACV requirements as tasked under the SIRFA system.

Technical Support for VNAF Photo Reconnaissance

Concurrently with the buildup of the VNAF's reconnaissance fleet, efforts were made to improve its ability to provide better and quicker exploitation of the photographic coverage. With the addition of the RF-5s to the inventory it was theoretically possible for the VNAF to perform the sort of quick tactical reconnaissance which could deliver aerial photography to ground commanders within hours. As late as December 1969, however, the VNAF had no specific means of even delivering aerial photos to its processing facility within an acceptable time span. As the 7AF I&M Study Group reported:[103/]

> *. . . the VNAF has no plan for delivery of reconnaissance products . . . to their Photo Exploitation Center (PEC) after the acquisition of the additional Phase II RF-5 capability. The 23d Wing at Bien Hoa (to which the six RF-5 aircraft are to be assigned) will have no organic photo processing exploitation element. Therefore the VNAF concept is that the six RF-5s will deploy from and return to Bien Hoa. The exposed reconnaissance film will be downloaded at Bien Hoa and transported to Tan Son Nhut by the most expeditious means.*

The Study Group strongly recommended that the VNAF be encouraged to develop an effective system for forwarding of reconnaissance products to the PEC. The Group also recommended that consideration be given to the feasibility of recovering the RF-5s at Tan Son Nhut to download the film. As of July 1971, however, the RF-5s were still downloading at Bien Hoa on all but high priority missions and the parent 23 Wing was forwarding the film via U-17 to the 5th Air Division at Tan Son Nhut which in turn, delivered it to the VNAF PEC within the 12 RITS. The lack of consistently available U-17 aircraft and similar difficulties in obtaining ground transportation to move the film from the flight line to the PEC frequently delayed film receipt, processing, and exploitation. RC-47 photography was handled more quickly since the aircraft's home station was Tan Son Nhut.[104/]

The VNAF's reconnaissance technical support problems did not end with its erratic film transportation system. Another problem area identified by the I&M Study Group was the need to improve the VNAF's actual film processing and exploitation facilities. As was the case with its flying assets (with the exception of the RF-5s) the VNAF's technical support facilities as late as 1969 were concentrated in the 716 Reconnaissance Squadron at Tan Son Nhut. The 716 RS had a capability to produce pinpoint, strip, and mosaic photography and did its own developing and printing, but its methods and equipment were outmoded.[105/]

Although 7AF I&M planners initially had considered providing the VNAF with its own reconnaissance technical facility, the Vietnamese PEC was finally located within the existing 12 RITS facility. It was believed that such an arrangement would permit the VNAF personnel to work with and benefit from the experience and expertise of their American counterparts.

The decision to train VNAF photo technicians and interpreters at the 12 RITS was based upon a genuine need. The VNAF possessed only a few photo interpreters and laboratory technicians capable of properly exploiting the film returned by the RF-5s and the RC-47s. The few skilled technicians who were available had been trained many years earlier by the French.[106/]

The phasing-in of VNAF technical personnel into the 12 RITS operation began in May 1970. The only significant difficulty encountered was in the quality control standards for film processing. American photo-lab technicians noted that the Vietnamese tended to be lax in maintaining high standards for processing and equipment maintenance. However, with the turnover of several Versamat processors and other laboratory equipment, a significant improvement was noted. Vietnamese technicians, when given their own facilities and equipment, showed pride of ownership and the earlier quality control problems largely disappeared.[107/]

UNCLASSIFIED

VNAF RECONNAISSANCE FLOW

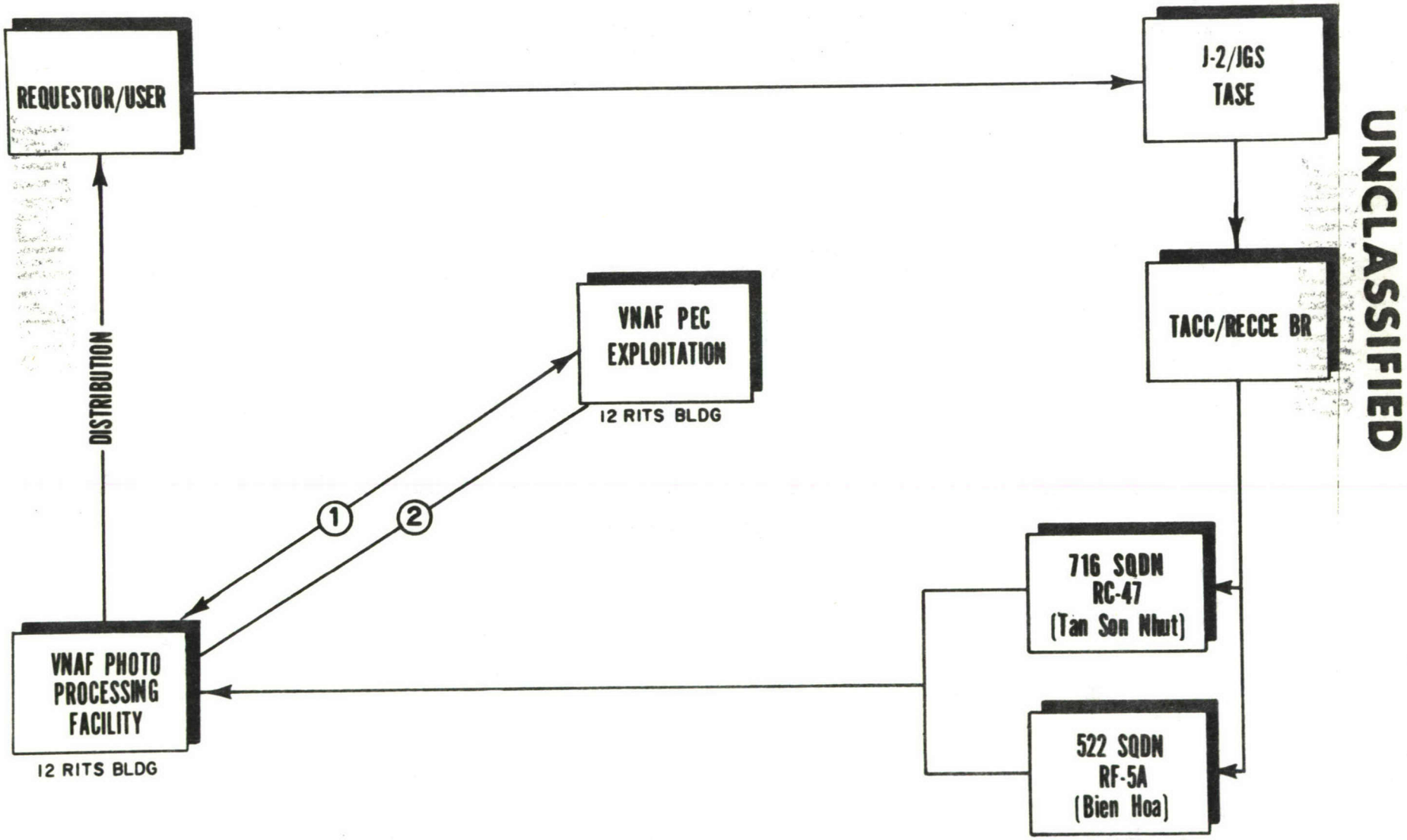


FIGURE 20

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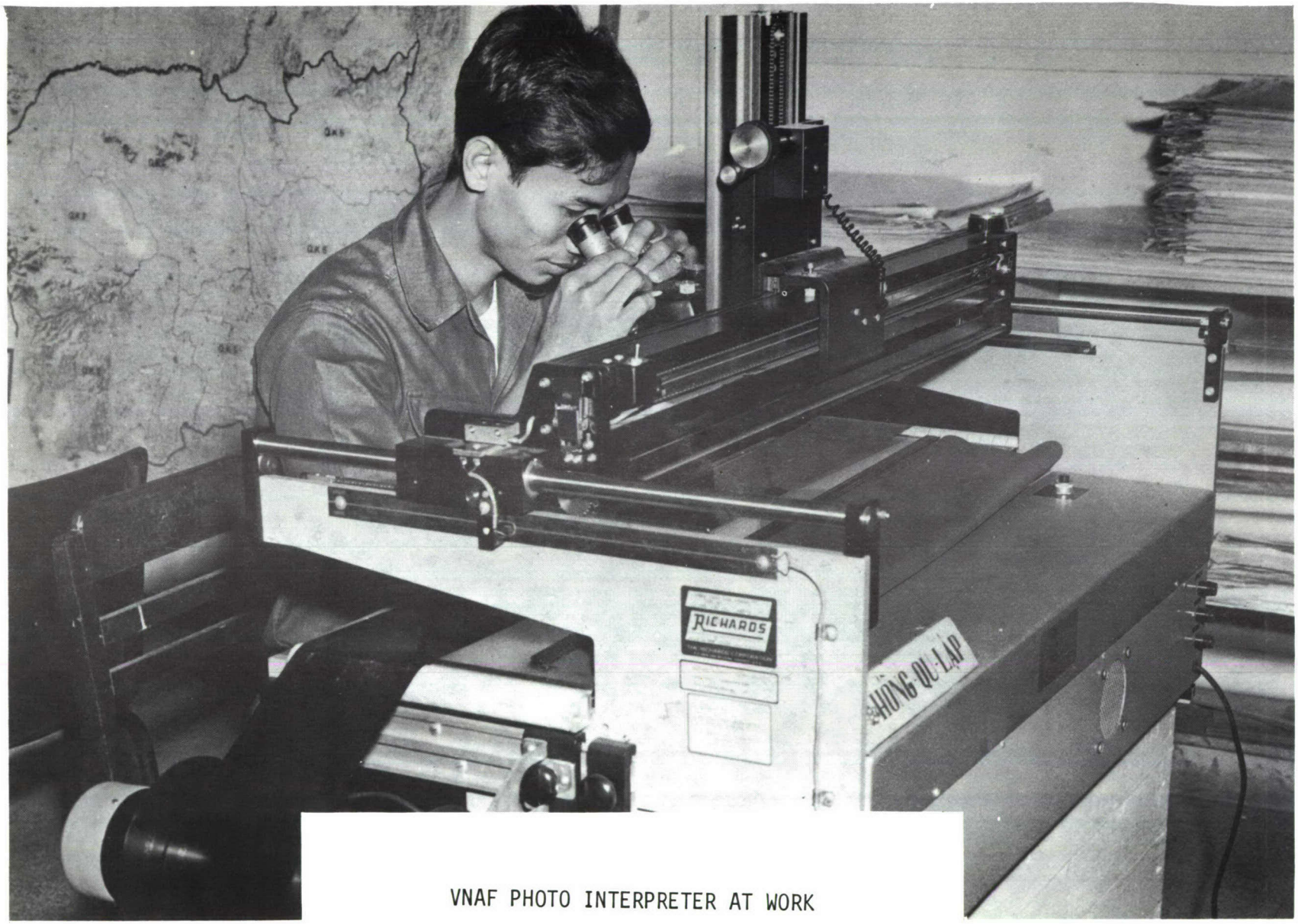
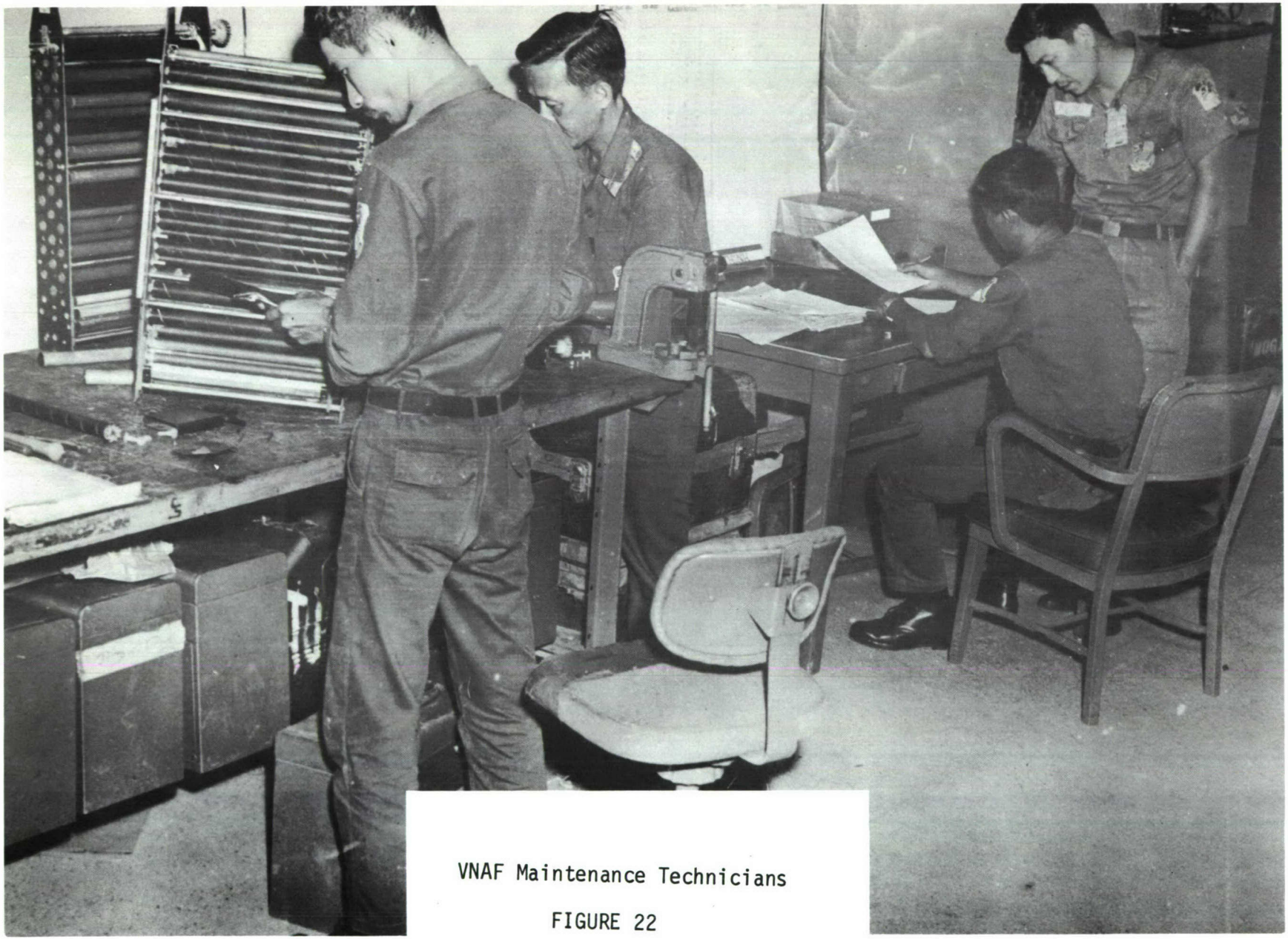


VNAF PHOTO INTERPRETER AT WORK

FIGURE 21



VNAF Maintenance Technicians

FIGURE 22

By July 1971, the VNAF's photo exploitation effort, while still in its infancy, was producing promising results. The PEC, located within the 12 RITS, consisted of approximately 2,200 feet of floor space, 40 interpreters and technicians, and the equipment needed to enable the PEC to support all Joint General Staff reconnaissance requirements. In January, seven VNAF photo interpreters were placed on 12 RITS exploitation teams for two months of training. Rotation among teams permitted the Vietnamese to gain experience in each of the geographical areas under aerial surveillance. Several officer photo-interpreters were also sent to the Armed Forces Air Intelligence Training Center at Lowry AFB to receive further interpretation training. A comparison of IPIRs and SUPIRs written independently by VNAF and USAF photo interpreters, using the same roll of film, indicated that the Vietnamese were "achieving mission readouts comparable in quality to those produced by USAF photo interpreters."[108/]

A final support problem, still unresolved, concerned the disposition of photo-derived intelligence from VNAF mission. As of July, the IPIRs and SUPIRs written by VNAF interpreters were being manually typed in sufficient quantities to insure distribution to the J-2 and J-3 sections of the Joint General Staff, as well as to the specific requester/user. There were no other standard addressees for the PEC-produced photo-intelligence reports. As a 12 RITS report noted:[109/]

Increased utilization of intelligence gleaned from VNAF reconnaissance could be achieved if other interested agencies were recipients.

Airborne Radio Direction Finding (ARDF)

Planning for the turnover to Vietnamese forces of USAF and Army ARDF assets in Southeast Asia began in December 1969 when the Director of the National Security Agency (NSA) established working groups to formulate plans to Vietnamize the mission. Inherent in this decision was the stipulation that the transition process was not to degrade the American ARDF effort.[110/]

At the time when NSA's working groups were being formed, the ARDF resources of the Republic of Vietnam were extremely limited. The ARVN had flown a small ARDF effort, generally from two to four missions each day, in U-6 aircraft for several years. The 716 Reconnaissance Squadron furnished the aircraft, the pilots, and airframe/engine maintenance. The ARDF equipment was operated and maintained by personnel from the Special Systems Technical Branch (SSTB), which was directly responsible to the J-7 (Communications and Electronics) elements of the Vietnamese Joint General Staff.[111/] By early 1970, the ARVN ARDF effort still amounted to only four percent of the total SEA ARDF effort. The Phase II programmed improvements made no provision for increasing the Vietnamese ARDF force even though MACV considered it to be a critical mission.[112/]

A basic assumption in American withdrawal plans was that the ARVN and the VNAF would still need to locate Communist forces with ARDF equipment. The areas to be covered were large, from the DMZ area down along the Laotian and Cambodian borders to the southern tip of the Republic, and the existing fleet of VNAF U-6As was inadequate for the task. Because of this, 7AF planners urged an increase in the ARDF force during Phase III. They also favored the EC-47 for the role in place of the previously considered U-6 or U-8 aircraft then in use by the VNAF and the U.S. Army. The EC-47 was considered far superior to the U-6 as an ARDF platform because it offered a 360-degree direction finding capacity; had the ability to work targets above an undercast; possessed a day-and-night navigation system as well as multiple signal handling capacity; and had the space for later improvement and sophistication of equipment.[113/]

April 1971:	Begin classroom training for ARVN ARDF operators.
May 1971:	Begin flight checkouts of ARVN ARDF operators under the supervision of USAF Security Service (SS) instructor-operators, in 360 TEWS aircraft.
1 December 1971:	First group of VNAF navigators to start ARDF ground school training.
31 December 1971:	Training of VNAF maintenance personnel for ARDF equipment to begin.
Second Quarter, FY 73:	VNAF's 718 Reconnaissance Squadron to be activated Twenty EC-47s equipped with the ALR-34 ARDF system

to be turned over to the 718 RS from the resources of the 460 TRW.

First Quarter, FY 74: 718 Reconnaissance Squadron to become operational at Tan Son Nhut Airfield.

Implementation of the above schedule was begun on time. The USAF's 6994 Security Service Squadron and 460 TRW along with its subordinate TEW squadrons were tasked with the necessary training responsibilities. The Security Service, through the 6994 SS, provided ground school instruction and flight checkout of the ARVN ARDF operators and maintenance personnel, while the 360 TEWS, stationed at Tan Son Nhut, provided the aircraft and prepared curriculum materials for the flight crew checkout program.[114]

The first class of 14 ARVN ARDF equipment operators entered training on 1 April 1971. On 13 June, 10 were graduated and began their checkout flights, manning two or three missions each day. Three students were held over for remedial training (it was anticipated that they would graduate) and one was eliminated from training for lack of aptitude.[115] On 14 June, the second ARDF operators class entered training with two members of the first class serving as instructors along with 6994 SS personnel.

With minor exceptions all programmed action dates in the ARDF turnover have been met. The quality of personnel provided by the ARVN for training has also been generally satisfactory. As Colonel Leon S. Inge, 6994 SS Commander, commented: "The ARVN has provided the very best they

have for operator training."[116] Perhaps inevitably, however, deficiencies in the preparatory training of the ARVN operators have been found. USAF instructors noted, for example, that ARVN Morse-intercept training tapes were of "classroom quality" and did not satisfactorily duplicate actual conditions, i.e., varying signal strength, frequent garbles, repeats, etc. Further training using actual field recordings had largely alleviated the problem as of the date of this report.[117]

Although the Programmed Action Directive for the ARDF turnover specified that all Vietnamese trainees be bilingual, language barriers were also encountered. The first class of ARDF operators contained a few students whose language proficiency was inadequate to cope with this situation in the future. Two of the original class of operators were kept on as instructors at the school. With the start of navigator and maintenance training in December the problem had the potential of becoming more acute. Due to its rapid expansion the VNAF had continually been short of qualified personnel.[118]

A lack of secure training facilities was another problem encountered by 6994 SS personnel as they prepared for the first class of ARDF operators. After an unproductive survey of USAF resources at Tan Son Nhut Airfield, the necessary space was finally found within the Joint General Staff compound. From a security standpoint the facility proved adequate, but the need to shuttle classes to and from the flight line for training sessions in the aircraft emphasized the need for classroom space closer

to the aircraft parking ramp. Another problem has resulted from security restrictions that permitted Vietnamese personnel in the flight checkout program to fly only in ARDF EC-47s equipped with ALR-34 equipment. Since the 460 TRW's ALR-34 assets were dispersed throughout its operating locations, last-minute aircraft maintenance substitutes occasionally required that Vietnamese trainees be left off flights. The planned concentration of all ALR-34 equipped aircraft at Tan Son Nhut Airfield will alleviate this problem in the near future.[119/]

The requirement that the Vietnamese fly only on ALR-34 equipped aircraft led to one final and awkward situation in the ARDF turnover program. Initially, security restrictions forbade acknowledgement to the Vietnamese of the more advanced ALR-34/35 ARDF systems. Questions were inevitably asked when ARVN operators were dropped from missions because of the non-availability of ALR-34 equipped aircraft. The Vietnamese could also note obvious external differences (such as antenna configurations) in the EC-47s parked on the Tan Son Nhut ramps. After an awkward period, the existence of more advanced equipment was admitted. Vietnamese questions were met by an explanation that the more advanced ARDF equipment was needed to fulfill urgent USAF needs and also that the systems were highly sophisticated and required elaborate maintenance facilities.[120/] These explanations appear to have been accepted without rancor by the Vietnamese, who may well be reluctant to undertake any more maintenance requirements than they already have.

CHAPTER V

TACTICAL RECONNAISSANCE IN SEA: 1971 AND BEYOND

Deactivation of the 460 TRW

On 27 July 1971, the 460 TRW at Tan Son Nhut (one of the two USAF tactical reconnaissance wings in SEA and the only one in South Vietnam) terminated its operations in SEA and subsequently relocated to COMUS. The Wing's RF-4C squadron, the 12 TRS, stood down from operations late in July to prepare for deployment to the squadron's new home at Bergstrom AFB, Texas.[121] Other elements of the 460 TRW were also preparing to relocate. The three RB-57Es of Detachment 1, which had served in SEA since 1966, were being readied for transfer to CONUS in late August. The long and productive career of the RB-57s in the Air Force's reconnaissance inventory appeared to be ending since they were scheduled for deactivation and storage at Davis-Monthan AFB, Arizona.[122]

The rest of the Wing, including its personnel and equipment, were being reassigned as the needs of the service dictated. The WS-430B PPIF had already closed down in early July. Its photo interpreters and laboratory technicians were reassigned to the 12 RITS, where they continued to do first-phase IPIR readout for the Wing prior to its stand down. The PPIF itself was also going home, first to the Ogden Air Materiel Area at Hill, AFB, Utah, for rehabilitation and overhaul. Later it would move again, this time to serve with the Air National Guard units at Meridian, Mississippi and Fort Smith, Arkansas.[123]

A SEA mission still remained, however, for the Wing's TEW squadrons. The three squadrons and their reliable "Gooneybirds" were to remain in place, flying their invaluable ARDF/SIGINT missions in support of SEA-based units. An increasingly important task for the TEW squadrons in the future would be the job of training VNAF flight crews as a part of the program to transfer the EC-47 ARDF mission to the Vietnamese by 1973.

The deactivation of the 460 TRW meant that all SEA photo reconnaissance requirements would be filled by RF-4C aircraft from Udorn RTAFB. The LORAN capability of the Udorn aircraft, together with the KA-82 cameras transferred from Tan Son Nhut Airfield, appeared to insure that adequate photo reconnaissance resources would be available to meet the tactical requirements of the shrinking U.S. force in SEA. Similarly, the continued presence of the 14 PPIF, the 432 RTS and the 12 RITS would provide ample technical support for all of the remaining photo reconnaissance units. Adequate ELINT support also seemed assured by the 13 EB-66s at Korat, although another dry season campaign might require augmentation of the force. In the end, the future size, composition, and tenure of the reconnaissance force in SEA would depend largely upon political factors beyond the influence of theater reconnaissance managers.

Some General Themes

The continuing drawdown of U.S. forces in SEA was only one of several trends in reconnaissance operations in 1970 and 1971. Other general

A "Family Portrait" of the 460 TRW

FIGURE 23

themes included; (1) increased emphasis upon "Vietnamizing" the SEA reconnaissance effort, (2) the need for a real-time reaction capability to locate perishable tactical targets, and (3) the emphasis upon improved sensor systems for the USAF's tactical reconnaissance force.

In July 1971, the aerial reconnaissance portion of the VNAF Improvement and Modernization program was still in its early stages. Programmed Action Documents had established a general outline for the future, but actual implementation of these programs was just beginning. The photo reconnaissance program was the closest to achieving an operational status. All of the programmed RF-5As were on station and had begun flying missions in support of JGS, 7AF and MACV collection requirements. The VNAF's Photo Exploitation Center at Tan Son Nhut was also clearly capable of handling all VNAF photo technical support needs. As far as the PEC's operations were concerned, a major problem for the future was the need for the VNAF to establish faster means of transporting exposed aerial film to the PEC for exploitation and to develop a system for distributing photo intelligence to field commanders on a more timely basis.

To the casual observer, only one final question regarding the VNAF's photo reconnaissance capabilities remained and that was whether or not the Vietnamese reconnaissance fleet could perform rapid high acuity area searches. The RC-47 was capable of covering wide areas with fairly good image resolution but its slow speed made it unsuitable for performing time-sensitive missions. The RC-47 was also highly vulnerable to enemy

ground fire. The RF-5A, on the other hand, had the speed necessary to perform time-sensitive missions and to avoid enemy ground fire, but its cameras lacked the high resolution and area search capability needed to locate SAM sites, enemy LOCs, and other search targets. Ideally, the VNAF reconnaissance force should have the ability to perform fast, relatively high acuity pinpoint, strip, and area coverage. Neither the RF-5 or the RC-47 can presently meet these criteria. The solution to this problem might be a modification of the RF-5A to accept a different camera system with panoramic coverage desired.

The turnover of the EC-47 ARDF mission to the Vietnamese would require more time to complete than did the program for photo reconnaissance assets, primarily because of the complexity of the equipment involved and the need to train equipment operators, flight crews, and maintenance personnel.[124/]

Another major theme of the period covered by this report concerned the methods employed to strike reconnaissance-generated targets. In general, two types of reconnaissance targets were recognized: (1) "hard" targets, such as barracks complexes, base areas, etc., that were relatively permanent, and (2) "perishable" targets, such as troop columns and truck convoys that would disappear in a matter of minutes or hours. The former could be covered by reconnaissance and struck almost at leisure. The latter, however, posed a considerable challenge to the tactical air commander.

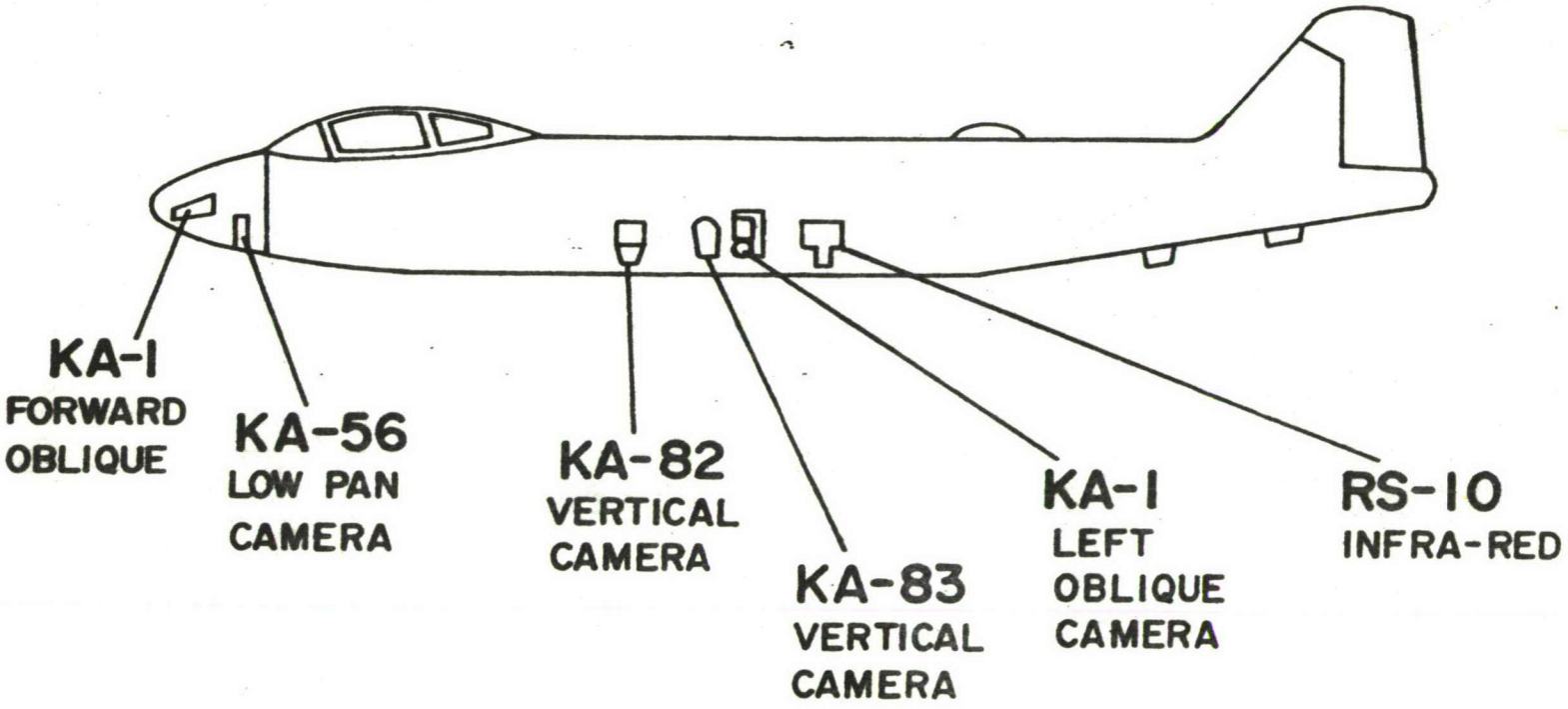
Usually, the "normal" reconnaissance targeting cycle could not be applied to perishable targets. Truck convoys, bulldozers working on roads, and even SAM sites could disappear in the time it took for a photo reconnaissance aircraft to return to its base and have its exposed film exploited.

Virtually the only reliable method of dealing with perishable targets was the utilization of hunter-killer teams to seek out the enemy and strike him. The best known and most effective hunter-killer team was the FAC/strike aircraft combination, although the EC-47/FAC/strike combination in the BLUE BEETLE program was also yielding valuable results. Until an in-the-cockpit sensor readout system or an air-to-ground image transmission capability is operational, the hunter-killer teams seem to be the most viable method of dealing with the perishable target problem.

A final theme in the reconnaissance story was the need for new and improved sensor systems. The requirement for better infrared and side-looking airborne radar sensors had already been stated through appropriate channels, and the need for a new medium altitude sensor for the RF-4 also had been recognized. Reliable, high acuity cameras, capable of accommodating higher speeds and altitudes as well as greater "G-forces" caused by jinking to avoid enemy ground fire will be urgently needed in the future to insure the survivability of aircraft and aircrews and to obtain adequate aerial photography for field commanders.

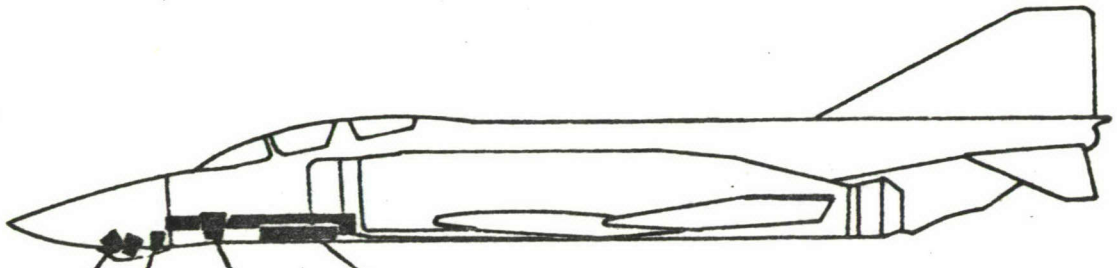
APPENDIX I

A TYPICAL
RB-57 SENSOR CONFIGURATION



APPENDIX II

A TYPICAL
RF-4C SENSOR CONFIGURATION



KS-72
FORWARD OBLIQUE or VERTICAL CAMERA
POSITION

AAS-18
INFRA-RED

KA-55 or (2)**KS-72** or **KA-82**
HIGH ALTITUDE PANORAMIC CAMERA
SPLIT VERTICAL CAMERAS
PANORAMIC HIGH RESOLUTION CAMERA

KA-56 or **KA-1**
LOW ALTITUDE PANORAMIC CAMERA
VERTICAL CAMERA

APPENDIX III

PRIMARY TACTICAL RECONNAISSANCE SENSORS

SENSOR	DESCRIPTION AND USAGE
KA-1	Framing, 9 x 18 inch format, vertical sensor, A two camera system commonly called "Split Verts." Presents large scale, small area coverage. Poor resolution and large format usually hampers detailed readout. A single KA-1 can be placed in the vertical or forward oblique positions.
KA-55	Panoramic, 4 1/2 x 19 inch format. 90 degree sweep. High altitude sensor, Primary use is area cover, LOC readout and mosaic production. Produces acceptable stereo.
KA-56	Panoramic, 4 1/2 x 9 inch format. 180 degree sweep. A good sensor for low altitude detailed readout and plotting.
KA-82	Panoramic, 4 1/2 x 29 inch format, 140 degree sweep. A high altitude sensor, gives good area coverage in stereo. This is a high resolution system and is useful for large area detailed readout. Acceptable for uncontrolled mosaic material.
KA-83	Panoramic, 4 1/2 x 50 inch format. High altitude system used primarily for area cover.
KS-72	1. Vertical Configurations: a. Split Verticals: Two 4 1/2 x 4 1/2 inch framing cameras, commonly called "little lookers." Very good for detailed readout of small areas. Good scale due to wide range of focal lengths available. Good stereo.

b. Vertical: Single 4 1/2 x 4 1/2 inch frame, used as a vertical camera with a short focal length to achieve large area coverage. Produces large area vertical stereo coverage.

2. Oblique Configurations:

a. Nose oblique or Forward oblique: Primarily used for perspective and orientation. Gives a view of ground covered from pilot's vantage point.

b. Left oblique and Right oblique: Good stand-off photography. Sometimes gives a better look under tree canopy than vertical cameras.

APPENDIX IV

RF-4C SENSOR SYSTEMS

Sensor	Lens	Position in Aircraft	Suitable Altitudes (Ft)*	Remarks
KS-72		NOB, LOB, ROB, SV, NV	200 to 50,000	Day or Night
KS-72	3"	NOB, NV	200 to 50,000	Only 3" or 6" For night NV, SY
KS-72	6"	NOB, NV, LOB, SV, ROB	200 to 50,000	Only 3" or 6" For night NV, SY
KS-72	12"	LOB OR ROB, SV	1500 or above	
KS-72	18"	LOB OR ROB, SV	3000 or abord	
KA-56	3"	Hi Alt Station	200 to 1500	Day only. Fifty-six percent overlap only.
KA-55	12"	Hi Alt Station Lo Alt Station, NOB	9000 or higher	Day only
T-11	6"	Hi Alt Station Stabilized Mount	3200 to 50,000	Day only
AN/AAS-18 Infrared			100 to 2000	WX is a limiting factor
KA-82	12"	Hi Alt Station, panoramic	2000 to 15,000	
KA-1	36"	Low Alt Station, Vert	6000 or higher	

*Altitudes expressed in feet above actual ground level.

FOOTNOTES

CHAPTER I

1. (TS) CHECO Report, Reconnaissance in Southeast Asia 1961-1966, Hq PACAF, 25 October 1966, pp. 1-10. (This extract classified SECRET.)

2. (TS) Ibid.

3. (S) CHECO Report, Reconnaissance in SEAsia July 1966-June 1969, Hq PACAF, 12 September 1970, p. 10.

4. (S) Ibid., p. 11.

5. (S) Report, Subject: "Summary of Air Operations in SEA," Hq PACAF, December 1966, p. 4-1.

   (S) Hq PACAF DOOR Letter, Subject: Review of Draft Project CHECO Report: USAF Tactical Reconnaissance in Southeast Asia, July 1969-June 1971, 20 January 1972. (Hereafter cited as Hq PACAF Door Letter.)

6. (S) CHECO Report, A Single Manager for Air in SVN, Hq PACAF 1 July 1968, p. 1.

7. (C) SOUTHEAST ASIA Data Base Retrieval, Hq 7th AF. (Hereafter cited as SEADAB Retrieval.)

8. (S) History, 432 TRW, July-September 1969, Volume 1, p. 12.

   (S) Hq PACAF DOOR Letter.

9. (S) History, 7AF, January-June 1970, Volume 1, Pt I, p. 42.

10. (S) History, 432 TRW, October-December 1970, Volume 1, March 1970, pp. 5, 14 and 16.

11. (S) COMMANDO HUNT V Report, Hq 7th AF, May 1971, p. 192. (Hereafter cited as COMMANDO HUNT V.)

12. (S) Report, Subject: "DOPR Staff Actions, 11 September-3 October 1970," Hq 7th AF.

13. (S) Ibid.

14. (S) Command Status Book, Hq 7th AF, May 1971, pp. A-3 and A-4.

(S) Hq PACAF DOOJT Letter, Subject: CHECO Report--USAF Tactical Reconnaissance in Southeast Asia July 69-June 71 (U), 14 January 1972. (Hereafter cited as Hq PACAF DOOJT Letter.)

(S) Hq PACAF DOOR Letter.

15. (S) Study, Subject: TAC RISE Concepts, Hq 7th AF (DOPR), 19 September 1968.

(S) Hq PACAF DOOR Letter.

16. (S) Study, Subject: TAC RISE Concepts, Hq 7th AF (DOPR), 19 September 1968.

17. (S) Interview, Topic: 12th RITS Operations. With Colonel L. G. Ardoin, 12th RITS Commander, by the author at Tan Son Nhut AB, 11 June 1971. (Hereafter cited as Ardoin Interview.)

(S) Hq PACAF XPR Letter, Subject: Project CHECO Report--Tactical Reconnaissance in SEA, 21 January 1972.

(S) Study, Subject: SAM Calls, 12th RITS, undated.

18. (S) Report, Subject: "PHOTINT," Hq 7th AF (INXCP), undated, TAB J. (Hereafter cited as PHOTINT.)

19. (S) "The COMPASS LINK Satellite Transmission System," Trends Indicators and Analysis (TIA), Hq USAF, April 1969, p. 1-1.

(S) History, 7th AF, January-June 1970, Volume I, Part I, p. 91.

(S) Hq PACAF INX Letter, Subject: Review of CHECO Report, USAF Tactical Reconnaissance in Southeast Asia, July 1969-June 1971, 21 January 1972. (Hereafter cited as Hq PACAF INX Letter.)

(S) CINCPAC INST S-0839, Compass Link Concept of Operations and Operating Procedures, 19 December 1968.

(S) AFSC Briefing, Category D Study of Compass Link System, undated and CBA Laboratories Document, Compass Link, 17 August 1968.

CHAPTER II

20. (S) Briefing, Subject: "Tactical Reconnaissance in Laos and NVN," presented by Hq 7th AF (DOPR), 8 January 1971. (Hereafter cited as "Tactical Reconnaissance in Laos and NVN.")

21. (S) Ibid.

22. (S) MACV Command History 1970, Hq MACV, April 1971, pp. VI-34, 36.

(S) Hq PACAF DOOR Letter.

23. (S) Report, Subject: "Historical Report, July-December 1970," Hq 7th AF (DOPR), 8 June 1971. (Hereafter cited as DOPR Historical Report.)

(S) Hq PACAF DOOR Letter.

(S) Hq PACAF INX Letter.

24. (S) "PHOTINT".

25. (S) Ibid.

26. (S) History, 7th AF (DOPR), July-December 1970, pp. 1-8.

27. (S) SEADAB Retrieval.

28. (S) MACV Command History 1970, pp. VI-34 to VI-37.

29. (S) Weekly Air Intelligence Summary (WAIS), Hq 7th AF, 3 July 1969, p. 23.

(S) Hq PACAF DOOJT Letter.

30. (S) History, 7th AF, January-June 1970, p. 186.

31. (S) History, 7th AF (DOPR), 1 January-31 March 1971, 16 April 1971, p. 8.

(S) Hq PACAF DOOR Letter.

32. (S) "Tactical Reconnaissance in Laos and NVN," p. 3.

33. (S) History, 432 TRW, January-March 1971, April 1971, p. 33.

34. (S) Command Status Book, Hq 7th AF, December 1970, pp. B-29 and B-30.

(S) Command Status Book, Hq 7th AF, May 1971, pp. B-28 and B-29.

35. (S) MACV Command History 1970, pp. VI-34 and VI-35.

(S) Hq PACAF DOOR Letter.

36. (S) Ibid.

37. (S) History, 432 TRW, January-March 1971, p. 15.

38. (S) History, 432 TRW, October-December 1969, p. 1.

(S) Hq PACAF DOOR Letter.

39. (C) Study, Subject: The Ban Karai SAM Site, 12th RITS, March 1971, p. 3.

40. (S) SEADAB Retrieval.

41. (S) COMMANDO HUNT V, p. 19.

42. (S) History, 432 TRW, January-March 1971, p. 28.

43. (S) "Tactical Reconnaissance in Laos and NVN," p. 4.

44. (S) History, 432 TRW, January-March 1971, p. 18.

45. (S) History, 432 TRW, October-December 1969, p. 32.

46. (S) History, 7th AF, July-December 1970, p. 256.

(S) Hq PACAF DOOR Letter.

47. (S) Briefing, Subject: LT GAP Targeting Techniques, presented to the author by Major S. F. Smith, 7th AF (DOPR) on 13 June 1971.

48. (S) Ibid.

49. (S) Ardoin Interview.

50. (S) History, 432 TRW, January-March 1971, pp. 33-35.

51. (S) Memo, Subject: Visit to DASC V, 432 TRW, undated, LT GAP Read File, 1971.

52. (S) Ibid.

53. (S) Ibid.

54. (S) Message, CINCPACAF to CSAF, Subject: Medium Altitude Camera, 191931Z Dec 70.

(S) Hq PACAF DOOR Letter.

55. (S) Letter, Colonel Cecil H. Rigsby, 460 TRW Commander to 7th AF DCS/Operations, Subject: The KA-82 Camera in RF-4C, 6 December 1970.

56. (S) Ibid.

(S) Hq PACAF DOOR Letter.

57. (S) Ardoin Interview.

(S) Hq PACAF DOOR Letter.

(C) CINCPACAF DOO Message 220251Z Jul 71.

58. (S) Command Status Book, Hq 7th AF, January 1970, pp. A-12 and A-13.

(S) Hq PACAF DOOR Letter.

59. (S) Command Status Book, Hq 7th AF, June 1968, p. A-8.

60. (S) COMMANDO HUNT V Report, p. 203.

61. (S) Ibid.

62. (S) Ibid.

63. (S) History, 7th AF (DOPR), January-March 1971, p. 4.

64. (S) Interview, Topic: Vietnamization of EC-47 Operations. With Colonel Leon S. Inge, 6994th Security Squadron Commander, by the author at Tan Son Nhut AB, 28 June 1971. (Hereafter cited as Inge Interview.)

65. (S) Ibid.

66. (S) History, 7th AF (DOPR), July-December 1971, pp. 1-10.

67. (S) Ibid.

68. (S) History, 7th AF (DOPR), January-March 1971, p. 5.

69. (S) Message, 7th AF DCS/Operations to 460 TRW, Subject: EC-47/ FAC Targeting Trial in Cambodia, 071030Z May 71.

70. (S) Inge Interview.

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72. (S) Ibid.

73. (S) Ibid.

(S) Message, 7th AF DCS/Operations to 504 TASG, Subject: BLUE BEETLE Program, 270900Z June 71.

74. (S) Inge Interview.

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75. (S) "Drone Reconnaissance," WAIS, 3 February 1968, p. 10.

76. (S) "Drone Reconnaissance," TIA, Volume XII, 1970, pp. 1-10.

77. (S) History, 7th AF, July-December 1969, Volume I, Part I, p. 178.

78. (S) "Drone Reconnaissance," TIA, Volume XII, 1970, pp. 1-10.

79. (S) TIA, Volume XII, 1970, pp. 1-12.

80. (S) PHOTINT, TAB F.

81. (S) TIA, Volume XII, 1970, pp. 1-10 to 1-13.

82. (S) Interview, Topic: 12th RITS Support of BUFFALO HUNTER. With First Lieutenant Charles Aldrich, Chief 12th RITS BUFFALO HUNTER Exploitation Team, by the author at Tan Son Nhut AB, 16 June 1971. (Hereafter cited as Aldrich Interview.)

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(S) Hq PACAF INX Letter.

(S) Fairchild Space and Defense Systems Document, Fairchild Aerial Photographic Systems, undated.

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(S) TIA, Volume XII, 1970, pp. 1-10 to 1-15.

84. (S) MACV Command History 1970, Volume I, pp. VI-35 to VI-37.

85. (S) Ibid.

86. (S) Ibid.

87. (S) TIA, Volume XII, 1970, pp. 1-10 to 1-14.

88. (S) Ibid.

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(S) History, 7th AF, July-December 1969, Volume I, Part I, p. 15.

(S) Command Status Book, Hq 7th AF, December 1970, p. C-6. (Note: In 1968, a Navy F-4 downed what was at the time thought to be a MIG-21. Subsequent investigation, however, proved that the downed "MIG" was actually a returning drone. The incident was made public in an Aviation Week and Space Technology article published 9 November 1970, p. 50.)

90. (S) TIA, Volume XII, 1970, pp. 1-11.

91. (S) Ibid.

92. (S) Ibid.

93. (S) Ardoin Interview.

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94. (S) CHECO Report, VNAF Improvement and Modernization Program, Hq PACAF, 5 February 1970, pp. 91-94.

95. (S) Study, Subject: VNAF Improvement and Modernization Phases and Related Plans, Hq 7th AF, 15 January 1970, Annexes A-P. (Hereafter cited as 7th AF VNAF I&M Study.)

(S) Hq PACAF DOOR Letter.

96. (S) Ibid.

97. (S) CHECO I&M Report, pp. 91-94.

98. (S) Ibid.

99. (S) Briefing, Subject: Mission of the 716th Reconnaissance Squadron, AFAT-1, undated, p. 5.

100. (S) Ibid.

101. (S) 7th AF VNAF Study, Annexes A-P.

(C) Study, Subject: VNAF Aerial Reconnaissance, 12th RITS, undated. (Hereafter cited as 12th RITS VNAF Study.)

102. (S) CHECO Report, VNAF Improvement and Modernization Program, pp. 91-94.

103. (S) 7th AF VNAF I&M Study, Annexes A-P.

(S) Hq PACAF DOOR Letter.

104. (S) 12th RITS VNAF Study.

105. (S) CHECO Report, VNAF Improvement and Modernization Program, pp. 91-94.

106. (S) Ardoin Interview.

107. (S) Ibid.

108. (U) Letter, CMSgt Samuel P. Fleming, NCOIC 12th RITS Exploitation Branch to RITSO, Subject: "Evaluation of VNAF Photo Interpretation Reports," 31 December 1970.

109. (S) 12th RITS VNAF Study.

110. (S) Programmed Action Document (PAD) 71-03, "Vietnamization Improvement and Modernization," Hq USAFSS, 26 February 1971, p. 4.

111. (S) Ibid.

112. (S) CHECO Report, VNAF Improvement and Modernization Program, pp. 91-94.

113. (S) 7th AF VNAF I&M Study, Appendix A-P.

114. (S) Joint Programmed Action Document (PAD) 71-7-12, Hq 7th AF (XP), March 1971, p. 3.

115. (S) Inge Interview.

116. (S) Ibid.

117. (S) Ibid.

118. (S) Ibid.

119. (S) Ibid.

120. (S) Ibid.

(S) Interview, Topic: "TEWS Operations." With Lieutenant Colonel G. S. Sagan, Operations Officer, 360 TEWS at Tan Son Nhut Afld by the author, 6 June 1971.

CHAPTER V

121. (S) Message, CINCPACAF to 7th AF (XP), Subject: PACAF PAD 71-21, 460 TRW 022322Z Jul 71.

122. (S) Ibid.

123. (S) Ibid.

124. (S) Inge Interview.

GLOSSARY

AAA		Anti-Aircraft Artillery
ABCCC		Airborne Battlefield Command and Control Center
ABLE MABLE	(S)	A reconnaissance task force of RF-101 aircraft which flew the original YANKEE TEAM missions in Laos, commencing in November, 1961.
ACIC		Aeronautical Charting and Information Center
ADAS		Auxiliary Data Automation System
ARC LIGHT	(S)	B-52 conventional bombing operations in SEA
ARDF		Airborne Radio Direction Finding
ARVN		Army of the Republic of Vietnam
AUTODIN		Automatic Digital Network
BANNER SUN		U.S. forces redeployment (drawdown) in Thailand through 30 June 1971.
BARREL ROLL	(S)	The northern Laos area of operations.
BIG SAFARI		An AFLC logistics support system for specialized projects.
BLUE BEETLE	(S)	The unofficial nickname for Forward Air Controllers who used EC-47 ARDF fixes to develop targets for air strikes.
BLUE CHIP		Seventh Air Force Command and Control Center which controlled out-country combat operations.
BLUE TREE		Tactical photo reconnaissance missions over North Vietnam.
BUFFALO HUNTER	(S)	Code name for SAC drone photographic reconnaissance operations in SEA (previous names were BUMBLE BUG and BUMPY ACTION).
CEP		Circular Error Probable

CINCPACAF		Commander-in-Chief, Pacific Air Forces
COMBAT APPLE	(S)	Special reconnaissance performed by SAC RC-135 aircraft in support of U.S. forces in SEA and national intelligence requirements.
COMBAT THUNDER		A method of determining LORAN coordinates.
COMINT		Communications Intelligence
COMMANDO HUNT	(S)	Name given to the air campaigns to interdict the flow of supplies through the southern panhandle of Laos to South Vietnam and Cambodia. The numeric designations changed with the semi-annual monsoonal shift.
COMPASS COUNT	(S)	An operational test of a laser camera system designed to provide covert night surveillance of enemy activities.
COMPASS LINK		Data transmission system capable of transmitting high resolution photo imagery via satellite using laser beam technology
COMUSMACV		Commander, United States Military Assistance Command, Vietnam
COSVN		Central Office for South Vietnam (Viet Cong headquarters)
DASC		Direct Air Support Center
DDBS		Deployable Data Base System
DF		Direction Finding
DIA		Defense Intelligence Agency
DISUM		Daily Intelligence Summary
DSU		Direct Support Unit
ECM		Electronic Countermeasures
ELINT		Electronic Intelligence

EOB		Electronic Order of Battle
ESM		Electronic Support Measures
FAC		Forward Air Controller
GIANT SCALE		SAC conducted SR-71 aerial reconnaissance of SEA.
IPIR		Initial Photo Interpretation Report
IR		Infrared
JGS		Joint General Staff (Republic of Vietnam)
Jinking		Random changes in the direction and altitude of aircraft flight path to degrade tracking by enemy AAA.
JOG		Joint Operations Graphic
LORAN		Long Range Airborne Navigation
LT GAP		Loran Targeting by Grid Annotated Photography
MACV		Military Assistance Command, Vietnam
NSA		National Security Agency
NVN		North Vietnam
PACAF		Pacific Air Forces
PEC		Photographic Exploitation Center; Pacific Command ELINT Center
PIPE STEM		A photo processing cell of the 15th TRS (Kadena) established at Tan Son Nhut AB, RVN, to support the photo reconnaissance conducted by RF-101 aircraft operating from Don Muang RTAFB, Thailand.
PPIF		Photo Processing Interpretation Facility
PROJECT CONTRAIL	(S)	An experimental project for passing EC-47 ARDF fixes to orbiting RF-101 aircraft.
RAVEN	(S)	USAF FACs in Laos under the control of the Air Attache, Laos.

RITS		Reconnaissance Intelligence Technical Squadron
ROE		Rules of Engagement
RS		Reconnaissance Squadron
RTF		Reconnaissance Task Force
RTS		Reconnaissance Technical Squadron
RVN		Republic of Vietnam (South Vietnam)
SAM		Surface to Air Missiles
SCATBACK		Seventh Air Force Flight Operations Division which provided courier support for the headquarters.
SEA		Southeast Asia
SEAOR		Southeast Asia Operational Requirement
Sentinel Lock		A method of determining LORAN coordinates
SIGINT		Signal Intelligence
SIRFA		SEA Imagery Reconnaissance File Automated
SLAR		Side Looking Airborne Radar
STEEL TIGER	(S)	The southern Laos area of operation.
SUPIR		Supplemental Photo Interpretation Report
TAC RISE		Tactical Reconnaissance Intelligence Systems Enhancement
TAC ROC		Tactical Air Command Required Operational Capability
Task Force Alpha	(S)	Computerized center which received and collated ground sensor data recording enemy vehicular movements in the STEEL TIGER area.
TEWS		Tactical Electronic Warfare Squadron
TRS		Tactical Reconnaissance Squadron
TRW		Tactical Reconnaissance Wing

VIGIL	Vehicular Intelligence Gained from Infrared and LORAN
VNAF	South Vietnamese Air Force
VR	Visual Reconnaissance
YANKEE TEAM	U.S. tactical air reconnaissance missions flown in Laos.

SECRET

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SECRET

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